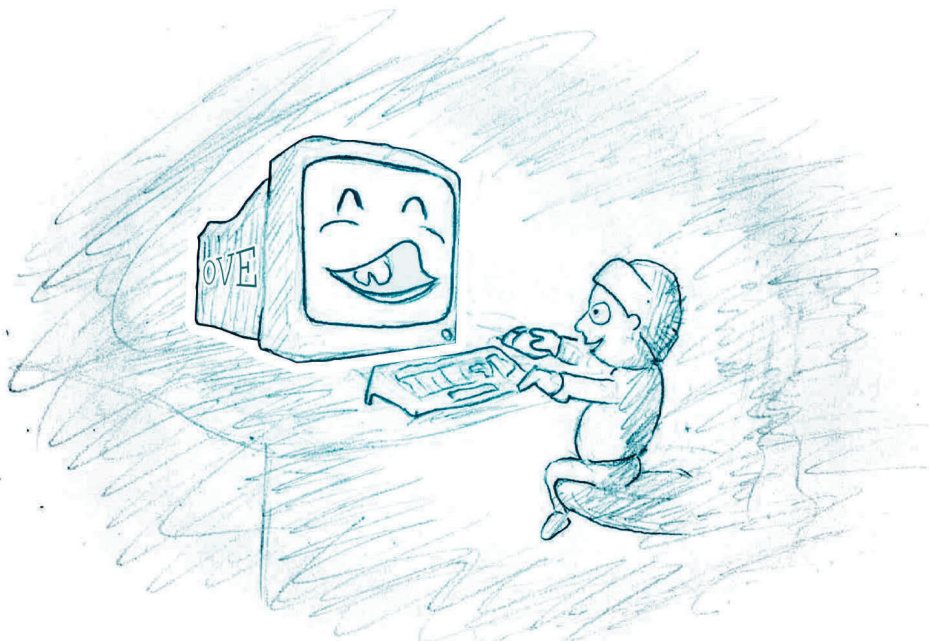


Britta Hannus-Gullmets

Scaffolding Writing

Four Children Explore Written Language
with Auditory Feedback from Speech Synthesis





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Abstract

This is a study about a teaching project in which children wrote texts on a computer with a digital aid, auditory feedback from speech synthesis. The study is a multiple case study with four cases, and the aim to increase knowledge of literacy skills development when writing is scaffolded by auditory feedback in collaboration with a teacher. Each case comprises a teaching period of five months, a school term. The point of departure is that literacy learning can be stimulated when a child and a teacher collaborate on a task which is slightly over the child's level of competence and the teacher assists, scaffolds, the child in an appropriate way. The task which the children performed in this study was writing words and texts which they chose themselves. The function of auditory feedback was to help the children to find the symbols of the speech sounds and to explore the structure of words and sentences.

The work is based on participant observation of children's writing, which is documented in fieldnotes, and documentation with keystroke logging and video recordings. The children's reading and writing skills are tested before and after the research period. Writing with auditory feedback took place in the children's school as lessons in a one-to-one situation with a teacher who also was the researcher.

Analytic attention has been focused on the development of literacy skills, on the teacher's ways of scaffolding the children's writing, and on the children's use of auditory feedback as a scaffold for writing.

The findings show that the three core characteristics of scaffolding were found in the material in this study, namely joint task engagement, contingent teaching and transfer of responsibility from adult to child. However, also challenges occurred. It was sometimes difficult for the teacher to find the right amount of scaffolding, and there are examples of both too much and too little scaffolding. The teacher occasionally wrote in a negative tune about the extent of the children's difficulties and sometimes attended more to formal details in the text than to the content of the stories that the children were writing, which was problematic for joint task engagement.

The greatest development of literacy skills occurred in letter knowledge for the youngest child and in double consonant and punctuation for the two oldest children. The two younger children worked with word reading and word writing and with the reading direction. If they had suggested a letter too early, they had difficulties in finding the letter again in its right place, probably because they had experienced a failure. The two older children worked on words with double consonant, and each of them worked in his own way. The children used auditory feedback especially for the aspects of written language which were of immediate importance in their literacy skills development at that time, the younger children to find the letter they needed and the older children to check their spelling. When the children made corrections, repair, in their writing, a tendency to more independence was found in repair organisation.

Keywords: scaffolding, literacy skills development, case study, speech synthesis

Abstrakt

Denna studie handlar om ett undervisningsprojekt där barn skrev texter på dator med ett digitalt hjälpmedel, auditiv feedback från talsyntes. Undersökningen är en multipel fallstudie med fyra fall, och syftet är att öka kunskapen om hur färdigheter i läsning och skrivning utvecklas när skrivandet stöttas av auditiv feedback i samarbete med en lärare. Varje fall består av en undervisningsperiod på fem månader, en termin. Utgångspunkten är att utvecklingen i läskunnighet kan stimuleras när en lärare och ett barn samarbetar kring en uppgift som är något över barnets kompetensnivå och läraren stöttar barnet på ett lämpligt sätt. Barnens uppgift i denna undersökning var att skriva ord och texter som de själva valde. Med hjälp av auditiv feedback skulle barnen hitta språkljudens tecken och undersöka ordens och meningarnas struktur.

Arbetet bygger på deltagande observation av barnens skrivande, som dokumenteras i fältanteckningar, och på dokumentation i form av videoinspelningar och loggning av tangenttryckningar. Barnens läs- och skrivfärdigheter testas före och efter projektperioden. Skrivningen med auditiv feedback skedde i barnens skola i form av lektioner med en lärare och en elev. Läraren var också den forskare som utförde undersökningen.

Analysen inriktas på hur läs- och skrivfärdigheterna utvecklas, på hur läraren stöttar barnens skrivande och på hur barnen använder auditiv feedback som en stötta, en byggnadsställning, för sitt skrivande.

Tre centrala drag kännetecknar den verksamhet som stöttar barn i deras lärande, nämligen ett gemensamt engagemang för uppgiften, en undervisning som är anpassad efter barnet och överföring av ansvaret från den vuxne till barnet. Dessa tre drag kan upptäckas i undersökningens resultat, men det fanns också utmaningar. Ibland var det svårt för läraren att hitta rätt nivå i stöttandet, och det finns exempel på både för mycket och för litet stöttning. Problematiskt för det gemensamma engagemanget var, att läraren ibland skrev i en negativ ton om hur stora svårigheter barnen hade, och att hon ibland uppmärksammade formella detaljer i texten mer än innehållet i de berättelser som barnen skrev.

De största framstegen i läs- och skrivfärdighet skedde i bokstavskunskap hos det yngsta barnet och i användningen av dubbel konsonant och skiljetecken hos de två äldsta barnen. De två yngre barnen arbetade med att läsa och skriva ord och med läsriktningen. Om de hade föreslagit en bokstav för tidigt, hade de svårt att komma på bokstaven igen vid dess rätta plats i ordet, troligen på grund av att de upplevt ett misslyckande. De två äldre barnen arbetade med dubbel konsonant, var och en på sitt eget sätt. Barnen arbetade med auditiv feedback speciellt på den aspekt av skriftspråsutvecklingen som var aktuell för dem just då. När de gjorde rättelser, reparationer, kunde man se en tendens till ökande självständighet i deras arbete.

Sökord: scaffolding, utveckling av läs- och skrivfärdighet, fallstudie, talsyntes

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1 Introduction

The development towards literacy brings a tremendous change in the life of a child. Learning to read opens a wide possibility for new experiences and learning to write gives the child access to a tool for the development of thinking and learning (Stanovich, 2000; Tolchinsky, 2006). Some children acquire literacy so fast that it is difficult even for a parent or a teacher to follow what happens. Some children meet challenges on their way towards literacy, and they need a long time, even years, to develop effective skills in reading and writing.

Questions arise about this process of development: What happens when a child learns to read and write? How does a child acquire the principles of written language? What can teachers and parents do to help the child with this task? What to do if the child faces difficulties? These questions linger in the background of my study. I have tried to find some answers to the questions as I have followed four children in their work with words and texts during a school term.

Much valuable research is made on children's development to literacy, more on reading than on writing, and more about the literacy skills of children at a certain point of time than about development during a longer period (Taube, Fredriksson & Olofsson, 2015). Much research focuses on assessment of achievement in reading at a certain point of time, for example in the PISA studies. Research is also made with assessment of reading and writing at subsequent points of time (Vellutino, Scanlon, Tanzman, 1998; Wolff, 2011, 2012), especially when interventions are evaluated. Another type of research, with ethnographic methods over time, describes what happens when children learn to read and write (Fast, 2007; Liberg, 1990; Skoog, 2012). These branches of research view literacy development to some extent from different angles (Myrberg, 2009). My research interest is the close study of development in reading and especially in writing, and with a special interest for cases where the development to literacy is not as smooth and fast as in most cases, and of tools that can be used as an aid for writing. Techniques, for example video recording and key stroke logging (van Waes, Leiten, Wengelin & Lindgren, 2012), make it possible for the researcher to get a close picture of what happens during development.

One-to-one tutoring methods are known to be effective to enhance reading and writing skills and to prevent failures (Wasik & Slavin, 1993). Scaffolding is a special kind of tutoring, "a process that enables a child or a novice to solve a problem, carry out a task or achieve a goal which would be beyond his unassisted efforts" (Wood, Bruner & Ross, 1986, p 90). The goal of scaffolding is not only the completion of a task, but it may result in development of task competence by the learner at a pace that would far outstrip his unassisted efforts (Wood et al., 1986).

The assistance from the adult is called a scaffold with a metaphor from building constructions. With the help of the scaffold, the child can manage to perform a difficult task and, also, learn how to perform the task independently.

The purpose of scaffolding can be described with the well-known words of Vygotsky (1962, p. 104): “What the child can do in co-operation today, he can do alone tomorrow”. A device or a tool can also be a scaffold. The children in this study write texts on a computer with auditory feedback from speech synthesis, and they do their writing together with a teacher. The children use speech synthesis as a scaffold for their writing, and the teacher scaffolds the children’s writing by encouraging them to use auditory feedback and by supporting their writing in other ways when it is needed, depending on the task and on the level of the children’s literacy skills.

Technology has brought new possibilities to schools, and it has presented new tools to be used to facilitate learning. Research has found that the use of digital tools can have a positive effect on the results of learning, even if the effects usually are not as great as sometimes was expected (MacArthur, 2013). Word processing with spell check and speech synthesis often has a good effect on writing and spelling, but the role of the teacher is crucial for how well technology can be used to enhance learning generally and also learning to read and write (Archer, Savage, Sanghera-Sidhu, Wood, Gottardo & Chen, 2014; Wise, Ring & Olson, 2000).

Speech synthesis or text-to-speech programs can be used to read out a written text and to serve as an aid for writing. Speech synthesis supplies auditory feedback on the writer’s actions, which means that speech synthesis pronounces letter sounds, letter combinations, words and sentences that the writer has produced. With these characteristics, speech synthesis can function as a scaffold for spelling and writing (Yelland & Masters, 2007). The role of the teacher is crucial also when a digital device is used as a scaffold (Yelland & Masters, 2007). My study follows children in their use of speech synthesis as a scaffold for writing, and studies how the teacher supports or prohibits the child to use synthetic speech. The children write self-generated texts, which means that the children decide themselves what words and texts they will write.

This study is a multiple case study with four cases. As a case study, it is an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context (Yin, 2009), and thus offers a rich, “thick” description (Merriam, 2009).

Literacy is a concept which can have a very broad meaning. In this study, literacy means the ability to use and produce written and printed material, also on the screen and on the keyboard. A text-to-speech program is used in the study, which means that there are some traits of multimodality. Literacy as the ability to handle pictures and images or as a wider cultural ability is not included in this context.

This study follows four children, all boys, in their literacy development in five months. The boys write texts with auditory feedback from speech synthesis on a computer. This working method offers a possibility to follow how the children write words and texts, what difficulties they encounter, and how they use the auditory feed-back to overcome problems in their writings. The focus is on writing, but the children also read the texts they have created. All the boys are

“struggling readers and writers”, which means that their teachers have recommended them for extra training in reading and writing, because they have not performed as well as their classmates.

1.1 Motives

Finding close descriptions of developing literacy skills in research literature is not so easy. Some ethnographic research studies the circumstances around literacy learning more than literacy learning as such. Some experimental work gives a picture of the level of skills at certain time points and finds connections and causes, but do not present the whole picture of the development in an actual case. A motive for this study is that close descriptions of the process of children’s literacy learning are needed. The course of events in actual cases in children’s reading and writing can shed light on general theories of literacy learning. According to Parrila and Protopapas (2017), there is a growing interest to supplement current research with idiographic studies and person-centred analyses.

The Finnish national core curriculum for basic education (Finnish National Board of Education, 2014) mentions the development of children’s basic knowledge in reading and writing towards more fluency as a goal for the first two grades. The work-life of today and life in society more generally demand a high level of literacy in every person, which means that also children with some difficulties in literacy learning must have the possibility to develop their reading and writing well.

Digital technology can supply tools for compensation of deficient skills, in assistive technology, but also supply tools which can be used for learning. Speech synthesis can be used both for compensation and for learning (Fälth & Svensson, 2015). However, research on how speech synthesis can be used for literacy learning, both learning of the correspondence between speech sounds and letters, and for learning spelling and writing, seems to be relatively scarce. More research is needed in this area. Research on speech synthesis as a tool for literacy learning is needed in its own right, as a study of the use of a digital tool for everyday learning in school life. Analysing how children write words and text with feed-back from synthetic speech also gives a possibility to study how children use speech sounds and letters and compound them to words during their learning to literacy.

Both EU documents and the Finnish national core curriculum emphasise the role of ICT in learning. The European Agency for Development in Special Needs Education (2013) had a project named “Information and communication technology for inclusion”. Main focus of the project was using ICT to support the learning opportunities of every learner, and especially to support learners who may be vulnerable to exclusion from educational opportunities.

The Finnish national core curriculum for basic education (Finnish National Board of Education, 2014) mentions multiliteracy and ICT competence among

the seven important competencies which are described. ICT is mentioned as an important citizen competence, both as a competence for itself and as a part of multiliteracy. The pupils are expected to learn how digital tools are used for varying purposes and to see their influence in everyday life. The national core curriculum emphasises that schools need to create learning environments in which students can use a wide range of ICT tools in ever more creative ways, and that schools need to use ICT tools to enhance and support learning (Vahtivuori-Hänninen, Halinen, Niemi, Lavonen & Lipponen, 2014). In my study, the children use a digital tool, speech synthesis, and are acquainted with its use in everyday life as an aid in learning to spell and write.

1.2 Aim of the Study

In my study, I followed a teaching project with four children who wrote texts with auditory feedback from speech synthesis during a school term. I wanted to study how the children's literacy skills developed during the period and how they used auditory feedback as an aid for their spelling and writing. I wanted to study how the teacher assisted the children with their writing in a one-to-one tutoring situation. The participating children were "struggling readers and writers", and I wanted to follow literacy development and the use of auditory feedback with children whose advancement in literacy has happened with some difficulties and delays.

The overarching aim of the study is to increase knowledge of literacy skills when writing is scaffolded by auditory feedback from speech synthesis. The specific aim of the study is twofold: to follow literacy learning during a period of text-writing with auditory feedback from speech synthesis, and to study the process of scaffolding, which means how children use auditory feedback as a scaffold for their writing and how the teacher scaffolds the children's work.

1.3 Positioning of the Study

The study is a multiple case study with four cases. The case is a period of teaching in a one-to-one tutoring situation. The most important basis for the performance of the case study is Yin's (1995, 2009, 2014) description of case studies. Yin's (2009 p. 18) definition of a case study is the following:

"A case study is an empirical inquiry that investigates a contemporary phenomenon in depth, especially when the boundaries between phenomenon and context are not clearly evident. The case study inquiry copes with the technically distinctive situation in which there will be many more variables of interest than data points, and as one result relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result benefits from the prior development of theoretical propositions to guide data collection and analysis."

The theoretical framework for my study is the concept of scaffolding (Wood,

Bruner & Ross, 1976) and its functions, means and intentions (van de Pol, 2010; Stakes, 1998; Tharp & Gallimore, 1988). With scaffolding as a core concept in the study, both scaffolding through interaction between teacher and student, and scaffolding with a tool, the view of learning is built upon Bruner's interpretation of Vygotsky's theories (Bruner, 1962, 1986; Vygotsky, 1962, 1978; Wood, Bruner & Ross, 1976). The learner's active exploring and the teacher's active guiding and instruction are the elements which are understood to push development forward.

The goal of scaffolding in my study was to help children to write words and text and to enhance their learning of literacy skills in that way, and because of that, my study relates to theories of literacy learning. Reading comprehension, written expression, listening comprehension, and oral expression are viewed as related yet unique language systems (Berninger, 2009; Berninger & Abbot, 2010). The use of auditory feedback in writing in my study is motivated by theories about the great importance of phonological awareness and understanding of letter-sound correspondences for literacy development. Phonological and phonemic awareness is since a long time known to be one of the most important elements in early stages of learning to read and write, and phonological deficits are seen as the core of the problem if difficulties arise (Høien & Lundberg, 2000; Stanovich, Cunningham & Cramer, 1984; Vellutino, Fletcher, Snowling & Scanlon, 2004). Letter knowledge is the most important prerequisite for learning to read and write (Scarborough, 1998), and the correspondence between phoneme and grapheme is a great task for the learner to master. Writing with auditory feedback can offer a possibility to investigate the phoneme/grapheme correspondence, and a possibility to explore how words are created by linking the speech sounds of the letters together.

The children in my study decided themselves what words they wanted to write, and they wrote self-generated text. When children write their own texts, wider aspects of literacy development than letter/sound correspondence enter the scene (Tolchinsky, 2016), and the letters are used in a functional context (Hagtvet, 2009). A framework for my thinking about the children's work with writing is Berninger's theory of developing writing consisting of text generation, transcription and executive functions (Berninger, 2009; Berninger & Abbot, 2010; Berninger & Winn, 2006).

Writing to read is an activity which has been more often combined with a view of literacy which especially stresses the close relationship of spoken and written language and the interaction of speaking, reading and writing (Liberg 1990). To some extent, my study is in the draught of two divergent views of literacy.

A picture which can be used to describe scaffolded writing (Figure 1) is borrowed from the theory of activity systems (Hayes; 2006, Postholm, 2015, Russel & Yanes, 2003). The subject is the child who writes a text using mediating artefacts, and the subject is also the teacher who tries to help the child with writing and with learning. Speech synthesis and the keyboard of the computer and other tools for writing are mediating artefacts. Interaction between the

teacher and a child, especially in the shape of scaffolding, is also a mediating artefact. The object or motive is related to the goal of the activity. The outcome refers to the changes which the activity system produces, which in a school context would be learning. The object in this case is the text which the child is working on. The outcome is not only the ready-made text but, more important, the child's progress in literacy skills.

The subjects share tools in their activity. The subjects are also members of other activity systems where rules can be different, and the subjects can have different goals. If there are problems in cooperation between subjects, the reason can often be found in differences in the elements in the activity systems, for example rules or goals (Russel & Yanes, 2003; Hayes, 2006; Postholm, 2015).

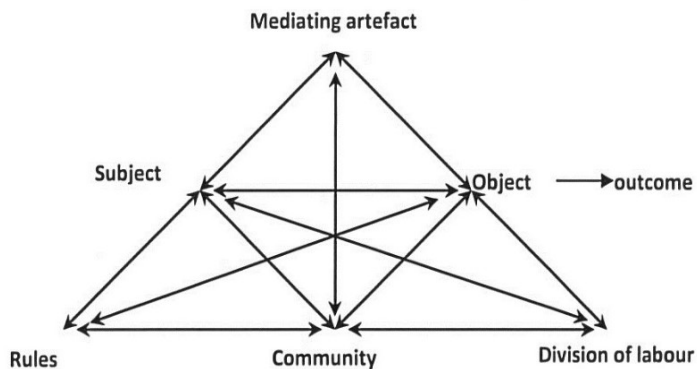


Figure 1. Scaffolded writing in an activity system

My study concentrates on the course of events in the upper part of the triangle. Rules, community and division of labour, which have their places in the bottom triangle, naturally influence what happens in the upper triangle. The rules of the school and the society, the school and the school class as a community and the division of labour between teachers and between teacher and pupil are all circumstances which influence the work of the children and the teacher in the teaching situation. In this study, the main attention will be on the course of events in the upper triangle.

1.4 The Organisation of the Text

The text begins with an overview of relevant aspects of written language, of the concepts of literacy, of reading and writing, and reading and writing difficulties. The following chapter describes the concept of scaffolding, namely scaffolding used for instruction. Next chapter is an overview of research on speech synthesis

in literacy learning. After these three theory chapters, the method chapter follows. Chapter five is about case study as a research method and about the method of the actual study. Chapters six to nine are the result chapters. Four chapters deal with the results from the four cases. In chapters ten and eleven the results from the cases are compared and discussed.

2 Learning to be Literate

The acquisition of language is one of the most interesting and most intriguing aspects in the development of a young child. Research on language acquisition (Bruner, 1983, 1990; Clark, 2016) has emphasised that language develops out of communication and is conveying a message, and that the development happens in close interaction with caretakers and in a certain context.

Literacy learning is an important part of language acquisition. Learning to use language in written form is no less interesting and intriguing than language learning overall (Cain, Compton & Parrila, 2017, p 1). The core principles for acquisition of spoken language are also valid for literacy acquisition, but literacy acquisition has special characteristics of its own (Berninger & Abbott, 2010; Liberg, 2007; Lundberg, 2008; Wengelin, 2009) A written text is de-contextualized in a way that spoken language seldom is, and written language often has a more complicated construction than speech.

This chapter deals with the concept of literacy, with the characteristics of written language, with the concept of reading and writing and with the concept of reading and writing difficulties.

2.1 The Concept of Literacy

Literacy is traditionally understood as the ability to read and write. The United Nations Educational, Scientific and Cultural Organization (UNESCO) has the following definition of literacy on the website 2018:

“Beyond its conventional concept as a set of reading, writing and counting skills, literacy is now understood as a means of identification, understanding, interpretation, creation and communication in an increasingly digital, text-mediated, information-rich and fast-changing world. The understanding of the concept of literacy has developed from simply “the set of technical skills of reading, writing and calculating...to a plural notion encompassing the manifold of meanings and dimensions of these undeniably vital competencies. Such a view, responding to recent economic, political and social transformations, including globalization, and the advancement of information and communication technologies, recognizes that there are many practices of literacy embedded in different cultural processes, personal circumstances and collective structures” (UNRIC, 2017).

UNESCO’s definition views literacy in a context, which means that literacy can have different meanings in different circumstances. Skills to acquire knowledge through technology and abilities to understand complex contexts are important. The concept of literacy can also comprise skills to understand and use pictures, images, videos and multimedia, especially nowadays, when books to some extent are replaced by the screen, and texts to some extent are replaced by images (Kress, 2003).

In this study, literacy means the ability to use and produce written and printed material, also on the screen and on the keyboard. A text-to-speech device is used in the study, which means that there are some traits of multimodality. Literacy

as the ability to handle pictures and images or as a wider cultural ability is not included in this context.

2.2 Written Language

Many formal conventions in written language have no correspondence in speech. Such conventions are the directionality of print, rules of punctuation, the distinction between upper- and lower-case letters, the use of paragraphs and spaces, and these must be learned (Hall, 2009; Tolchinsky, 2006). Speech is a continuous stream of sounds, but a written text makes distinctions between words. A child learning to write learns to understand that a word is a unit of meaning, within which there are units of sound that need to be represented by symbols, namely letters (Riley & Reedy, 2000; Wengelin, 2009). With Vygotsky's (1962, pp. 98-99) words, the main stumbling block is the abstract quality of written language, to replace words by images of words, and that writing is a speech without an interlocutor, addressed to an absent or an imaginary person or to no one in particular.

In an alphabetic language, phonemes correspond to letters, graphemes. A phoneme is the smallest component of a spoken word which distinguishes between meanings. A phoneme relates to speech sounds in an abstract way, because speech sounds can vary (Lundberg, 2008; Read, 2009; Wengelin, 2009, 2013a), due to co-articulation, depending on what speech sounds are next to them in a word, or they can vary depending on their position in the word, but they still express the same phoneme.

The abstract character of phonemes can make it difficult for the learner to understand how spoken words should be divided into pieces for writing. The concept phonemic awareness is used for the ability to distinguish and manipulate individual sounds. Phonological awareness is a broader concept, which includes phonemic awareness, and includes the ability to hear and manipulate larger units of sounds like rhymes and syllables. Phonemic and phonological awareness is well-documented as an important factor in literacy learning, especially during the early stages (Elliot & Grigorenko, 2014; Høien & Lundberg, 1999, 2000; National Early Literacy Panel, 2008; Stanovich, Cunningham & Cramer, 1984; Vellutino et al., 2004) Training phonemic awareness supports literacy acquisition, especially when letters also are used (Elbro, 2004; National Reading Panel, 2000; Melby-Lervåg, Lyster & Hulme, 2012).

Letter knowledge is the most important prerequisite for learning to read and write, according to many researchers (Hammill, 2005; Lyytinen, Erskine, Kujala, Ojanen & Richardson, 2009; Piasta & Wagner, 2011; Scarborough, 1998; Taube et al, 2015, pp 27-34), even more important than phonological awareness and vocabulary. The best way to help young readers in their development towards literacy would consequently be to teach them the letters.

In their research review, Piasta and Wagner (2011) found that letter training

gave good results in letter knowledge, but the effect was not as great as expected. They also found that training in letter knowledge had effect on other early literacy skills, but the effects were small, and the casual relations were not quite clear. Piasta and Wagner (2011, p 27) concluded that their results did not disprove casual relations between alphabet knowledge and literacy skill development, but their findings stressed the need of research on questions concerning the role of alphabet knowledge development and later literacy abilities.

Lyytinen and his research group constructed a computerized game for letter learning, and they found good results for the development of early literacy skills. In a vast longitudinal study, Lyytinen and colleagues found that children with risk for reading and writing difficulties had problems with discriminating speech sounds at an early age, which could explain why it was so difficult for them to learn the connection between letters and phonemes (Lyytinen et al., 2009; Saine, Lerkkanen, Ahonen, Tolvanen & Lyytinen, 2011).

The first written word most children learn to recognise is their own name, and the first word which they know how to write is their own name (Tolchinsky, 2016, p 150). The name of the child is the gateway to literacy (Liberg 1990). When young children try to write words, they often use the letters in their own name (Tolchinsky, 2006).

Young children often try to write words as soon as they know some letters and have some understanding of the alphabetic principle, but not yet have learned the conventional spelling of many words. They use so called invented spelling (Read 2009), which means that they use their ability to analyse the sound structure of a word and to find a corresponding letter, as well as they can.

Languages have various systems of correspondence between phonemes and graphemes. Languages like Finnish and Italian have a consistent or transparent orthography, which means that there are almost the same number of phonemes and graphemes with a correspondence close to one-to-one. English has much more phonemes than graphemes and their correspondence is very complicated, English orthography is non-consistent or opaque. Swedish orthography is considerably more consistent than English, but not as consistent as Finnish and Italian (Taube 2007; Seymour, Aro & Erskine, 2003). Reading and writing acquisition usually happen faster in a language with a consistent orthography, and in English, reading acquisition seems to take more time than in many other European languages (Aro & Wimmer, 2003; Georgiou, Torppa, Manolitsis, Lyytinen & Parrila, 2012; Seymour et al., 2003;).

2.3 The Concept of Reading

Reading development is often understood as the key to literacy. The definition of reading literacy in The Programme for International Student Assessment, PISA, 2015 is: "Reading literacy is understanding, using, reflecting on and engaging in written texts, in order to achieve one's goals, to develop one's knowledge and

potential, and to participate in society” (OECD 2013). The PISA-definition describes the fully developed reading literacy, the goal of reading development.

A description of reading which is more useful for studies of developing literacy is “the simple view of reading” (Gough & Tunmer, 1986; Hoover & Gough 1990).

A formula summarises the simple view of reading:

Reading Comprehension = Decoding x Language Comprehension.

The word “simple” in “the simple view of reading” does not mean that reading is a simple process, it means only that the formula is simple. The concept “reading comprehension” is used for “reading” in the formula, showing that reading comprehension is the real essence, the meaning and goal of reading. Both decoding and language comprehension are necessary for reading comprehension, and if one of them is zero, the result, reading comprehension, is also zero.

The simple view of reading was confirmed by research (Florit & Cain 2011; Garcia & Cain, 2014; Ripoll Salceda, Aguado Alonso & Castilla-Earls, 2013) and also modulated. Decoding appears to have a greater impact on reading comprehension for children in their first years of schooling, and language comprehension influences reading comprehension more during later school years. In languages with non-consistent orthography like English, decoding skills also influences reading comprehension more and during a longer time, compared to languages with consistent orthography (Torppa, Georgiou, Lerkkanen, Niemi, Poikkeus & Nurmi, 2016) like Finnish or Spanish. Children learn relatively fast to decode words in languages with consistent orthography, and after that, reading comprehension depends more on language comprehension.

The simple view of reading can explain a great deal of differences between children’s reading comprehension, but not everything. About one fifth (Taube, Fredriksson & Olofsson, 2015, p 26) of the difference is estimated to depend on unknown elements. Individual experiences like exposure to print, reading habits and motivation can be among the unknown elements, influencing both decoding and language understanding (Heimann & Gustafson, 2009). Some researchers (Dalby, 1992; Taube, 2007) have added motivation to the formula for the simple view of reading:

Reading Comprehension = Decoding x Language Comprehension x Motivation

The reading and the writing processes are closely connected to each other, almost like two sides of a coin (Ehri, 2000; Lundberg, 2008). The first sign of literacy is often that a child tries to write something, which means that writing development can be ahead of reading development at the early stages of literacy development (Liberg, 2007; Lundberg, 2008, p 48).

2.4 The Concept of Writing

Writing and reading are reversible processes. Writing, or spelling, is the encoding process of turning units of sounds into symbols, reading involves

decoding these symbols back into sounds to formulate words. Reading and writing (spelling) need to be taught in close relationship and simultaneously to support each other in an integrated writing-reading approach (Berninger, 2009; Ehri, 2000; Lundberg, 2008; Wengelin & Arfé, 2018). However, much less research is done on writing than on reading. Many writers mention that, especially on younger children's writing, there is not very much research (Berninger & Abbot, 2010; Taube, Fredriksson & Olofsson, 2015).

Like in reading, the character of the actual language influences the development of writing and spelling. In English, with a non-consistent orthography both for reading and spelling, the development to correct spelling takes many years. In Finnish, with a consistent orthography for both reading and spelling, the development proceeds relatively fast. In Greece, the orthography of writing is non-consistent, and the orthography of reading is consistent. The development of writing in Greece resembles the development of writing in English, and the development of reading is more like the development of reading in Finnish (Georgiou et al., 2012). The orthography of writing in Swedish is of an intermediate character (Taube, 2011, p 76), much more consistent than in English, but not as consistent as in Finnish.

"The simple view of writing" was presented by Juel, Griffith and Gough (1986) as a parallel to the simple view of reading. They proposed that writing is composed of spelling and ideation. Both spelling and ideation are complex processes and can be broken down into sub-skills, but the division of writing into two processes is simple and clear. Spelling is empty without being able to form ideas, but ideas cannot come out on paper without spelling as a driving mechanism. Hagtvet (2009) made a somewhat similar formulation of "the simple view of writing" :

Writing = Encoding x Conveying a message.

Berninger and her co-workers (Berninger & Amtmann, 2003) made their own version of the simple view of writing. They built on the widely applied Hayes-Flower (1980; Hayes, 1996) model for skilled writing as planning, translating and revising. "Translating" in the Hayes-Flower model describes how ideas are translated into written language. The cognitive processes are integrated with motivation and affect (Hayes, 1996), and working memory and long-term memory have an important role. Hayes (2006) mentioned activity theory as an interesting framework for the study of writing. The Hayes-Flower model is about adult, skilled writing, and Berninger and her colleagues elaborated the model for children's beginning and developing writing.

The cognitive processes necessary for writing do not all develop at the same rate in a child, and planning, translating and revising are not always balanced at a given time in development, because planning and revising usually develops later. In Berninger's model (Berninger & Amtmann, 2003), translating is comprised of two separable components, text generation and transcription, which also may develop at different rates. Text generation is the ability to translate ideas into linguistic representation in memory. Transcription is the ability to create written symbols to signify the linguistic representation in

memory with handwriting or keyboarding, and spelling. In young children transcription demands a great deal of attention during writing, but later transcription proceeds more automatically, so there are more resources for text generation. If transcription skills, handwriting, keyboarding, and spelling, do not develop properly, the whole writing system can be disturbed (Berninger, 2009).

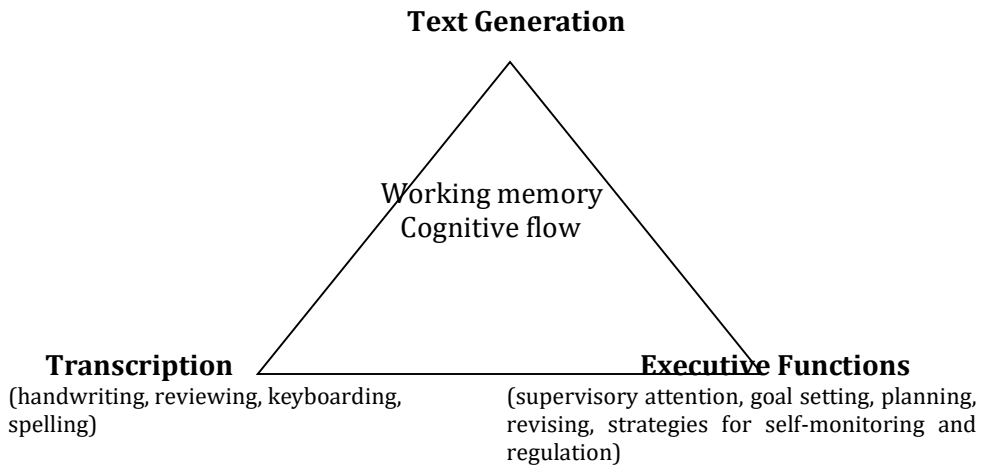


Figure 2. *The Not-So-Simple View of Writing Model*

Berninger (Berninger & Amtmann, 2003) also added cognitive processes and sub-processes which were not outlined in the Hayes-Flower model. The three major elements in Berninger’s model are text generation, transcription and executive functions. Transcription skills and executive functions support text generation in an environment of working memory.

The executive functions in Berninger’s model are attention, planning, reviewing, revising and strategies for self-regulation. In a revision, using results from neuropsychology and findings from brain imaging technology, Berninger and her co-workers named their model “The Not-So-Simple View of Writing Model” (Berninger & Winn, 2006, p97). Changes were made in the description of working memory, and in the description of supervisory attention in a central role among executive functions (Figure 2).

Motivation and affect play central roles in writing processes (Boscolo, 2009; Hayes, 1996; Hidi & Boscolo, 2006;), especially in the classroom. The attitudes to writing can be negative and lead to avoidance and to difficulties to stay on task. Willingness to write is the basis for all the work with writing, and it is often a problem for novice and for struggling writers. Self-efficacy (Bandura, 1997) and interest are two concepts closely connected to motivation for writing (Boscolo, 2009). Interest can be created both by an interesting topic and by ways to organise writing, such as collaborative methods and meaningful tasks. Self-efficacy or sense of competence in writing is the other core component of motivation (Bruning & Kauffman, 2016), and self-efficacy is strongly influenced by earlier success or failure. Self-efficacy grows from mastery experience, as

successful performance in the domain is the most potent source of self-efficacy in any domain (Bandura 1997).

The genre which children use the most is narrative, a type of text which deals with events, which they themselves have experienced or observed. Even very young children can produce a narrative with events in temporal order. On a later stage, most children can make narratives with a superstructure, which means that the persons, the time and place are first presented, and then some complication or problem appears, which is solved in the end of the text (Alamargot & Fayol, 2009).

Stages are found in children's text-writing relating to text structure (Wengelin, 2013b). At the first stage of text-writing, the text transcription demands so much energy (Berninger & Amtmann, 2003), that a child's written language is even simpler than his or her spoken language. The text consists of main clauses with little variation. At the second stage of text-writing the sentences are more complicated with interrogative and exclamatory clauses, and subordinate clauses and connections of various kinds. At this stage the need of punctuation emerges more clearly (Hall, 2009). The third stage in text-writing means longer and more complex texts in various genres, like the types of writing demanded in later school years, and the fourth stage continues in adulthood as an elaboration of the third stage (Wengelin, 2013b).

As punctuation in written language has no counterpart in spoken language, it takes time for a young writer to develop understanding of punctuation (Hall, 2009). Young writers often fail to use punctuation, despite having been taught about it, depending on the substantial cognitive burden that writing tasks mean to them. End-of-line and end-of-piece punctuation is often used during the learning process. To understand the grammatical principles for punctuation can be difficult, so many children use an intuitive understanding of "what makes sense" to cope with punctuation (Hall, 2009). Comparatively little research has been made about the development of punctuation (Fayol, 2016).

The distinction of words with spaces is another characteristic of written language without a counterpart in spoken language. Children usually first learn to put spaces around function words like proper nouns, nouns and verbs, and only later they learn to put spaces around articles and auxiliary verbs (Tolchinsky, 2016).

2.5 Learning Spelling in Swedish

Swedish is a language of intermediate transparent or semi-transparent orthography (Taube, 2007). On a continuum of increasing consistency, Seymour et al (2003) placed English as the most non-consistent language, French as the next, then Dutch, Swedish, German and Spanish, with Finnish as the most consistent language.

Although Swedish is a semi-transparent language, there are some problems with the correspondence between phonemes and graphemes, which can be

difficult for a young learner. The sound /ʃ/, known as the “sje-sound”, has no letter of its own, and is written with combinations of letters, among others <sj>, <sk>, <skj> and <stj>. The sound /ç/, known as the “tje-sound”, and the sound /ŋ/, are also written with combinations of letters, <k>, <tj>, <ch>, and <ng>, <gn>, <nk> respectively. The sound /j/ has a letter of its own, <j>, but it is also written with other combinations. The letters <c>, <x>, <q>, and <z> have no sounds of their own, but they are used in many words (Taube, 2011).

An important prerequisite for spelling and writing is that the child can distinguish the phonemes in a word despite co-articulation, assimilation and reductions of sounds in spoken language (Lundberg, 2008; Read, 2009; Wengelin, 2009). When the child has caught the phoneme, the next task is to link it to the right grapheme.

Some Swedish consonant sounds can be difficult to distinguish for a novice reader: /b/p/, /d/t/ and /k/g/. The pairs are pronounced in the same place in the speech organ, the only distinction is voiced/voiceless. Some vowel sounds can also be difficult to distinguish: /y/-/ʉ/, /e/-/i/-/y/ and /ʉ/-/y/-/ø/ (Druid Glentow, 2006).

The system for double consonants is complicated, and it is often deemed to be the most difficult item to learn in Swedish spelling (Wengelin, 2013 b). Double consonant is used when the vowel is short, the syllable is stressed, and no other consonant follows in the syllable. The rules are complicated, and there are many exceptions. During a period of their development some children use double consonant too much, like a kind of “over-regulation” (Nauc ler, 1985, 1989). At least a half of all spelling mistakes (Elbro, 2004) that children make in Swedish are mistakes with the system of double consonant.

Consonant clusters with two and three consonants occur frequently in Swedish. Young writers sometimes omit consonants in clusters. The first and the last phoneme in a word is easier to observe than the phonemes in the middle of the word, according to the position effect, and they are not so often left out. Consonants are omitted more often than vowels, so it seems to be easier to recognize a vowel than a consonant, even if the vowel has an intermediate position in the word (Lindell, 2006, p 297-298).

The correspondence between phonemes and graphemes is not the only principle for writing in Swedish. Morphemes, the smallest language parts carrying a meaning, must also be distinguished. Swedish written language is morphophonemic, which means that words are spelled in the same way as their basic word, even if inflections have changed the pronunciation (Taube, 2007, 2011, Wengelin, 2013 a). The word “roligt” (funny), for example, the word “roligt” with “t”, an inflection ending, is spelled with <gt>, even if it is pronounced like /rulikt/.

2.6 Reading and Writing Difficulties

Development towards literacy can be challenging for some children, and difficulties in learning to read and write can appear. The concepts of reading and writing difficulties, reading disability, specific reading disability, dyslexia, and their unclear definitions have been discussed for many years and these terms have often been used interchangeably (Vellutino et al., 2004). Elliott and Grigorenko (2014), in their review of research in the field, recommended the concept “reading disability” to be used instead of “dyslexia”, which is no longer used as a category in the Diagnostic and Statistical Manual of Mental Disorders, DSM-5 (Jones & Kindersley, 2013). Elliott and Grigorenko (2014) used “reading disability” for decoding difficulties in relation to both single- word reading and the fluent reading of a text. They used “reading difficulties” for a broad group of different types of reading problems, including problems with accurate and fluent coding and problems with reading comprehension, (pp 40-41). Vellutino (2014) recommended more neutral terms, such as “reading difficulties”, “learning difficulties”, “atypical readers” and “struggling readers”.

The concept “struggling readers” is used for students who are low achievers compared to other students in the same setting or compared to test norms (MacArthur, 2013). In Cheung and Slavin’s study (2013) struggling readers are the third of students with the lowest achievement in reading, and in other studies struggling readers are students with results at least one standard deviation below the mean. Studies with focus more on writing than on reading use the concept “struggling writers”, for students “whose attainment in writing is significantly below the average for that age group” (Myhill, & Jones, 2018, p. 142).

This study will follow Vellutino’s (2014) recommendation and use the concepts “reading and writing difficulties” and “struggling readers and writers”.

Behind reading disability and behind reading and writing difficulties is a complex system of deficits causing the problems, and no single reason is found (Elliott, & Grigorenko, 2014; Parrila, & Protopapas, 2017). Deficits in phonological and phonic awareness, in rapid naming, or in both, are found in research, but not as single reasons. Deficits in attention, in short-term and working memory, and in auditory and visual perception, appear as risk factors which can impede development. Advances in neuroscience and genetics have shown that reading and writing difficulties can have a genetic component, but the connections are so complex that no simple explanation or recommendation can be made (Elliott, & Grigorenko, 2014). Environmental elements like quality of education, parent-child interaction and social and cultural conditions have an important influence, and the environment influences, the expression of genes, and the plasticity of the nervous systems in ways that are not fully understood (Elliott, & Grigorenko, 2014, p 121).

During the first school years, reading and writing difficulties usually appear as problems to remember the letters and their sounds, and to understand the phonologic structure of words. These difficulties are usually overcome after the

first school years, but difficulties with spelling and with written production often remain (Berninger, Nielsen, Abbott, Wijsman, & Raskind, 2008; Ehri, 2000). Later, other problems, such as reading fluency or comprehension become more salient, and the problems are more difficult to overcome (Blachman, Schatschneider, Fletcher, Francis, Clonan, Shaywitz, & Shaywitz, 2004; Elliott, & Grigorenko, 2014 p 138)

In a review of research on teaching methods that were shown to be helpful to diminish reading and writing difficulties (Taube, Fredriksson & Olofsson, 2015), following methods were found: Reading aloud for children at risk for reading and writing difficulties had a positive effect on their literacy development. Dialogic reading had the best effect, and pre-school and the three first years of school was the most favourable time. One-to-one tutoring programs in reading for at-risk children were also effective against failure in learning to read and write. Interventions to stimulate phonological awareness and sound-letter correspondence had the best effect in pre-school and during the first year in school. Interventions to enhance reading comprehension and interventions of mixed type had the best effect from the second year in school.

Teaching spelling directly and systematically had a good effect on spelling in all grades in elementary education, also on reading and phonological awareness. On the contrary, direct teaching on spelling had no effect on length and quality of writing. Teaching of strategies for writing, such as planning and revising, had a good effect on quality of writing (Graham, Harris, & McKeown, 2013; Taube et al., 2015). Error self-correction has been identified as the most critical contributing element to spelling achievement, and immediate self-correction was more effective than self-correction which happened later (McLaughlin, Weber & Derby, 2013). Use of technology had a positive effect on literacy learning, but the effect was usually small. The effect of technology, especially of word processing, was higher on writing than on reading (Taube et al., 2015). Information and communication technology did not as such bring great gains for development of literacy skills (MacArthur, 2013), but Elliott and Grigorenko (2014, p 151) found two longitudinal studies (Saine et al., 2011; Fålh, Gustafson, Tjus, Heimann, & Svensson, 2013) which gave some evidence for the value of computerized intervention for children with reading difficulties.

The characteristics of written language and the characteristics of the language in question create challenges and affordances for a young learner. The process of reading and the process of writing have their own characteristics but are also closely interrelated. Learning to be literate is a demanding task for many children, and good help from adults is necessary.

3 Instructional Scaffolding

Support from parents and teachers is of great importance for children's learning generally, also for children's learning to be literate, and one-to-one tutoring is an effective method for enhancing learning (Taube et al, 2015). Scaffolding is a special kind of support given during the learning process, which is tailored to the needs of the student with the intention of helping the student achieve his/her learning goals (Sawyer, 2006). Scaffolding often happens in a one-to-one situation or in a small group. Simply providing one-to-one assistance is not a sufficient measure (Rodgers, D'Agostino, Harmey, Kelly, & Brownfield, 2016) to ensure progress on complex tasks such as learning to read and write. Appropriate scaffolding requires accurate knowledge of the learner's skill levels, and is, according to Bruner (1986) "finely tuned to the capabilities and capacities of the child".

Scaffolding is a metaphor borrowed from the area of building: a temporary framework for construction in progress. Adults provide temporary assistance to children as they strive to accomplish a task just out of their competency (Stone, 1998). When the child can solve the task independently, the scaffold should be removed, just like a scaffold is removed when the building is erected.

3.1 The Concept of Scaffolding

Wood, Bruner and Ross coined the concept of scaffolding in their article "The role of tutoring in problem solving" (Wood et al., 1976). They used the concept scaffolding to describe the interaction between a tutor and a child that

"enables a child or a novice to solve a problem, carry out a task or achieve a goal which would be beyond his unassisted efforts. This scaffolding consists essentially of the adult or expert controlling those elements of the task that are initially beyond the learner's capacity, thus permitting him to concentrate upon only those elements that are within his range of competence" (p 90).

The task the children had to accomplish in the study of Wood and his co-workers (1976) was to build a pyramid of wooden pieces that could be fitted together in certain ways, and a tutor assisted them in their efforts.

The authors emphasised that successful scaffolding should not only help the learner to complete a task, but also help the learner to better understand what was involved in a successful completion of the task. A genuine change in understanding should be accomplished. When the child's understanding grew, there would be less and less need of the scaffolding of the same task. As a metaphor relating to constructing buildings, a scaffold is a support which is used during the construction, adjusted and eventually removed.

Before the learner can benefit from the assistance, the scaffolding, he must have some understanding of the task, which can be e.g. the building of a tower or the communication of an intent (Wood et al., 1976). "The comprehension of the

solution must precede production” (p 90), because otherwise there could be no effective feedback. The child’s new understanding of how to accomplish the goal is achieved via an ongoing interaction in which the adult provides carefully adjusted assistance.

3.1.1 Types of functions of scaffolding

In their study, Wood, Bruner and Ross (1976) characterised scaffolding with some essential functions of the tutor. They identified six types of functions. The first function is recruiting the learner to the task and evoking his interest in it. The second function is reductions in degrees of freedom for accomplishing the task, which means that the task is simplified so the learner can reach a solution with a reduced number of constituent acts. The third function is direction maintenance, which means that the tutor keeps the learner in pursuit of a particular objective, and also that the tutor inspires the learner to proceed and move to more difficult parts of the task in his work.

The following function, the fourth, is marking critical features. The tutor marks certain features of the task that are relevant and provides information about the discrepancy between what the child has produced and what would be a correct production. The fifth function is frustration control. Problem solving with a tutor should be less stressful than without. The tutor can help the learner with face savings for errors, and the tutor can also exploit the learner’s wish to please. The risk is in creating too much dependency. The sixth function is demonstration or modelling solutions to a task. The tutor demonstrates the solution in an idealized form and builds on the attempts the learner has made to reach the solution.

In approximately the same time period, Bruner (1975) also studied the development of child language, and he applied the scaffolding metaphor to the context of parent-infant communication exchanges. He showed how the interaction between the child and his caretaker helped the child to use words in his communication. In parents’ book-reading with their small children (Ninio & Bruner, 1978, Snow & Ninio, 1986) regularities were found which were looked upon as examples of patterns for enhancing the language acquisition of the child. Shared attention and joint action were shapes of interaction where scaffolding of language development occurred.

3.1.2 Influences from Vygotsky’s theories

In his studies of learning and instruction, Bruner was inspired by Vygotsky’s theories. Bruner (1962) wrote the introduction to the first English translation of Vygotsky’s *Thought and Language* (1962) which had been published in Russian in 1934, some months after the author’s death, but the book was not known in Western countries for a long time. Vygotsky’s view of the child as a social being from the start, who is developing through active interaction with caretakers, had influenced Bruner’s research. Vygotsky claimed that a child could learn difficult things if instruction was good and well adapted to the child’s level of

development, and that it was not necessary to wait for certain stages in the child's development until instruction could start. Vygotsky did not use the word "scaffolding", but Bruner and his co-workers used influences from Vygotsky's theories when they developed the concept.

The concept of scaffolding parallels Vygotsky's concept of the "Zone of Proximal Development" (ZPD), although Wood et al. (1976) did not mention ZPD. In *Thought and Language*, Vygotsky described experiments where children had solved difficult tasks with some adult help, and he stated that "the discrepancy between a child's actual mental age and the level he reaches in solving problems with assistance indicates the zone of his proximal development" (Vygotsky, 1962, p 103). The frequently quoted statement "What the child can do in cooperation today he can do alone tomorrow" is also from *Thought and Language* (p 104). Vygotsky's view of the capacities of the child also has consequences for teaching: "the only good kind of instruction is that which marches ahead of development and leads it; it must be aimed not so much at the ripe as at the ripening functions" (p 104). In a collection of Vygotsky's writings which appeared in English in 1978 with the title *Mind in Society*, the definition of the ZPD is the following:

"the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p 86).

The Zone of Proximal Development is the area where learning occurs and where instruction should work. In Vygotsky's words (1978, p 89), "the only good learning is that which is ahead of development". However, the learner's consciousness and control of a function can come only after he has already got a function well spontaneously mastered. The contradiction can be resolved when a tutor collaborates with the learner, and in a way "lends" his own consciousness to the learner. Cazden (1979) related Vygotsky's ZPD to scaffolding and suggested that the metaphor be expanded from the domain of parent-child interactions to teacher-student interactions. Bruner (1986) later acknowledged the relation between Vygotsky's concept of the ZPD and the metaphor of a scaffold, erected for the learner by the tutor, which he and his co-workers had developed.

3.2 Scaffolding Literacy Development

Bruner (1975; Ninio & Bruner, 1978) studied scaffolding with young children acquiring language and Wood, Bruner and Ross (1976) studied children building a pyramid of wooden pieces. Nowadays, scaffolding appears to be most fully developed in the field of literacy and the largest group of empirical research is about literacy (van de Pol et al., 2010). More research seems to be made on scaffolding reading development than on scaffolding writing and spelling.

3.2.1 Reading

Rodgers (2004) studied scaffolding reading with first grade children in one-to-one tutoring groups in Reading Recovery, which means that the children had been chosen to the groups because of problems with their reading. Reading Recovery is a one-to-one intervention for children having difficulty reading after one year at school. It consists of reading small books, writing small stories, often only one sentence, and of some analysis of words and parts of words also. The leading principle is that the child is enabled to act like a reader and writer. Rodgers studied the reading component, more exactly the part of the lesson in which the child read the text which was presented the day before and the teacher took a “running record”. She found that scaffolding was given on various levels, from the highest amount of support to the lowest: telling the student the solution, which meant the word or phrase, demonstrating a helpful action, directing the student to something helpful, and questioning the student. Scaffolding was of various kinds, and she concluded that the teacher’s role in scaffolding performance was very complex.

Rodgers and her co-workers (Rodgers, D’Agostino, Harmey, Kelly & Brownfield, 2016) studied what kind of scaffolding or contingent teaching was the most effective. They compared the activity of two small groups of Reading Recovery teachers, a group which had lower average gain scores at the end of the year, and a group which had higher average gain scores. They found that there were no significant differences for instructional contingency, which means the amount of information provided at difficulty, and no significant differences for temporal contingency, which means the frequency of help. On the contrary, there were dramatic differences for domain contingency, which means that the teacher focused on the topic for providing help.

The teachers who had the best results more often directed their scaffolding to the kind of topic which the student had overlooked. If the child for example had substituted “lady” for the word “mother”, he had used meaning and structure to solve the word, but he had overlooked visual information. If the child had substituted “matter” for the word “mother”, he had used visual information but not meaning. Scaffolding should be directed to helping the child to examine the visual information, the letters, of the word in the first case, and to consider meaning and context in the second case (Rodgers et al., 2016). Rodgers concluded that the nature of effective scaffolding is very complex, and the actions of the student as well as the actions of the teacher should be studied.

Rodgers and her coworkers (D’Agostino, Rodgers, Harmey & Blomfield, 2016) also studied a Reading Recovery group where information and communication technology was integrated in literacy instruction with the iPad app *LetterWorks*. The iPad app had positive effects on letter learning, but the teachers reported problems because there was a misfit between their beliefs about literacy teaching and learning and the app. The teachers preferred to work with tactile magnetic letters.

Scaffolding reading was also studied by Cole (2006), who studied teacher mediating behaviours during student oral reading in first grade. She described

three types of scaffolding: graphophonic, semantic-syntactic and pragmatics. Graphophonic scaffolding is about letters and their sounds, and semantic-syntactic scaffolding is about meaning and structure. Pragmatic scaffolding can be a smile and a touch. The teachers who used scaffolding were more effective in teaching the children to read. According to Cole, scaffolding was effective because the teacher could keep the task together as an entity, when the child was practising and learning parts of it.

Scaffolding was different at various levels of proficiency, for pre-word readers, word readers, and fluent readers. Novice readers had more scaffolding than more advanced readers. The teacher pointed more to the text, praised the children more and interrupted them more. The teacher was constantly moving between micro- and macro-level. Micro-level means separate words, and macro-level means the context and the meaning. If the teacher was too busy at the micro-level, reading comprehension could suffer.

Cole also discriminated primary and secondary cues: Primary cues relate directly to the text and keep the reading going. If the child hesitated or stumbled over a word, these cues supported fluency and reading comprehension. Secondary cues mean that the teacher reminds the pupil of rules, words that have been studied earlier, and short and long sounds. Some secondary cues could be characterised as failures: the pupil was told to “sound out” a word which was not regularly spelt or told as a matter of routine to sound out a word, several times.

3.2.2 Writing and spelling

Scaffolding writing was studied by Bodrova and Leong (1998, 2001, 2007a, 2007b) with pre-school children writing texts to their drawings. The children told the teacher what they wanted to write about their picture, and the teacher drew a line for every word in their utterance. The child repeated the utterance to the teacher and pointed to the lines. Then the children “wrote” something for each word, a scribble, a letter or some letters, depending on their skill, and “read” their writing to the teacher. The concept of a word is one of the most critical aspects of writing development in pre-school age, according to Bodrova and Leong (2007b). They found that the lines drawn to represent spoken words and separated by spaces could scaffold the emerging concept of a word.

Bodrova and Leong (1998) used the theories about materialisation and private speech from Vygotsky and his followers. The line for every word, drawn by the teacher and later by the child, is an example of materialisation, a material object to scaffold learning. When the child chooses an utterance to “write” down and to draw lines for, and when he for himself repeats the words and the whole utterance, he is using private speech. Materialization and private speech provide the scaffolding needed to support learning (Bodrova & Leong, 1998, p 4).

Play is an important activity in the life of young children (Roskos & Christie, 2007), and some of the texts in the studies were about planning their play (Bodrova & Leong, 2007a), which made the texts especially meaningful. Bodrova and Leong (1998, 2001, 2007a, 2007b) let the children make their own text, at first only one sentence, and gradually several sentences, and they used the

techniques materialization and private speech for the children's emergent writing. They applied the method of scaffolding writing for self-generated messages of young writers.

Scaffolding writing was also studied by Hobsbaum, Peters and Sylva (1996), but in a different context. They studied interaction between teacher and child in Reading Recovery in relation to the concept of scaffolding, and they studied the writing component. Hobsbaum et al. (1996) followed seventeen children and their teachers during the program. They studied patterns of interaction between teacher and child during sentence construction, especially "word cycles", which meant discussions about sounds and letters in a word which ended when the child had written the word.

They found a development in the patterns of interaction. In the first lessons the teacher initiated the word cycles and led the interaction, but the child was also actively suggesting what to write and what letters to use for the word. In the later lessons the child took more control of interaction, asked questions and wrote short words independently. The child initiated a word cycle only after he or she had independently written a word. Although the child had more control of interaction in the later lessons, the activity of the teacher, the scaffolding, did not fade. The level of difficulty rose when the child wrote longer sentences and more complicated words. The teacher and the child worked together on a higher level.

According to Hobsbaum et al. (1996) the interaction between teacher and child in the Reading Recovery groups was an example of scaffolding. The teaching was contingent, which means that the teachers assessed the child's level of competence and adjusted their activity to the child's capacity and to the difficulty level of the word. The scaffolding did not fade away, as scaffolding did in the classic experiment by Wood et al. (1976) with building of a toy tower, but when the task's difficulty level rose, scaffolding was done on a new level. The teacher's interactions moved from close intervention to essentially reactive support as the child directed his or her own writing to a greater extent. The authors stressed the distinction between a short-term experimental task and long-term instructional contexts where the curricular goals are ever-increasing. The authors found an explanation to the effectiveness of Reading Recovery in the fact that the teachers all the time operated at the upper edge of the children's Zone of Proximal Development, and that they raised the level of expectancy when the competence of the children rose.

Bereiter and Scardamalia (1987, 1993) describe two categories of writing: "the knowledge-telling-strategy" and "the knowledge-transforming strategy". Younger and less skilled children use the former strategy, which means that they just write down facts from memory. A more mature and more skilled writer makes revisions and changes focus from the content of the story to the language of the text and back again. For a young child, the absence of a listener is the most difficult aspect of written language to take into consideration when writing a text. The technique of writing and spelling is also difficult to learn for a young child.

A teacher or parent can facilitate the young writer's task with two types of scaffolding: procedural and substantive facilitation (Bereiter & Scardamalia, 1987). Procedural facilitation means that self-regulatory mechanisms are introduced to scaffold a task. Substantive facilitation means explicit guidance on the conventions and standards in writing.

Systems for scaffolding story writing and composition, planned to be used especially for students with learning problems, were developed by Graham and Harris (Graham, 2006) and Englert (Englert & Mariage, 2007, 2013; Englert, Raphael, Anderson, Anthony, & Stevens 1991). The Self-Regulated Strategy Development by Graham and Harris was used in Finland by Mäki, Vauras & Vainio (2002). Englert (Englert & Mariage, 2013) developed the Cognitive Strategy Instruction in Writing, a program specifically designed to support the writing performance of elementary students with learning problems.

3.3 Scaffolding with a Device

Scaffolding usually means a strategy that the teacher implements in order to support a learner, but the scaffold can also be a tool, a scaffolding device like a cue card, a computer or associated software. Yelland and Masters (2007) studied how primary school children worked in pairs with mathematic problems with the software *Turtle Path* and *Geo Logo*. The first year a group of children worked independently with the software, and the researchers observed them and helped them only when requested. The researchers made plans for scaffolding during the observation year, and during the second year another group of children were scaffolded by their teachers in their work with mathematic problems with the same software. The children worked more efficiently when they were scaffolded by the teachers, and they worked also with greater enthusiasm.

Yelland and Masters (2007) found three types of scaffolding: cognitive, technical and affective. Cognitive scaffolding meant that teacher and students discussed concepts and made plans and strategies for problem-solving. Technical scaffolding meant that the teacher helped the students to handle the hardware and software. Affective scaffolding meant that the teacher encouraged the students to stay on task, and that the teacher also encouraged them to higher levels of thinking and operating. Technical and affective scaffolding was soon reduced, and ultimately also the need for cognitive scaffolding diminished. The researchers found that the role of the teacher was critical in this context. Teachers should be confident in their approach and encourage children to take risks and realize that there is not always only one way to solve a topical problem. Teacher decisions about the level and type of scaffolding will depend on many factors which will include the nature of the task, the needs and interests of the children, the concepts and processes involved and opportunities to share ideas with peers or present them to an authentic audience.

Scaffolding is a dynamic concept that needs to be modified to suit the circumstances of implementation. However, several key characteristics of

scaffolding could be identified (Masters & Yelland, 2002; Yelland & Masters, 2007). The first feature has to do with the interaction between the learner and tutor. The interaction must be collaborative, and the learner's own intention should be the aim of the process. The second feature is that the scaffolding must operate within the learner's zone of proximal development. The tutor needs to be aware of the learner's current level of knowledge and then work to a certain extent beyond that level, drawing the learning into new areas of exploration. The third feature is that the scaffold is gradually removed as the learner becomes more competent, just like a scaffold used in the construction of a building is adjusted and finally removed. The final goal for the learner is to become independent, having internalized the knowledge required in order to complete a task. These three key characteristics of scaffolding are to a great extent identical with Stone's (1998) three key notions, which are described in the following chapter.

3.4 Criticism and Refinement of the Concept of Scaffolding

The concept of scaffolding has also been criticized. Some authors claim that the concept has become so broad in its meanings that it has become unclear in its significance, and the scaffolding construct is used synonymously with support (van de Pol et al., 2010). Grenfell (2009) criticized the concept of scaffolding for being used uncritically in the study of classroom learning, "especially when the Zone of Proximal Development ... is reinterpreted as scaffolding, defined then as the way by which learning is mediated by the teacher supporting problem solving before "handing over" knowledge to the learner." Grenfell illustrated his criticism with an example from a lesson in mathematics when the teacher gave the correct answer to a student who had answered quite wrong, and the teacher did so without asking how the student had been thinking about the problem, and without any further explanations.

Another point of criticism (Stone, 1998) is that, in many studies, the metaphor of the scaffold has been removed from its original theoretical context, and scaffolding is used as a teacher- initiated, directive instructional strategy. In the original meaning of the concept (Wood et al., 1976) the learner was looked upon as an active participant, and the tutor should respond to the activities of the learner. If the concept of scaffolding is used in harmony with the theoretical context of its roots, this point of criticism is unjustified.

Stone (1998) mentioned some other points of criticism, which he considered being at least partially justified. Scaffolding from peers is seldom studied, and the relation between adult and child is often idealized, with no conflicts. Scaffolding is sometimes understood as a ready-made blueprint and a structure which the adult imposes on the child, but according to Stone (1998), this is not in agreement with the original concept of scaffolding. Stone also reported his concerns about how the scaffolding metaphor is applied in the case of exceptional learners. Nevertheless, the mechanisms by which new learning takes

place during such adult-child interaction as scaffolding need greater specification.

Stone (1998) expressed his concern about using scaffolding in the field of learning disabilities. It is often claimed that direct instruction is more effective in special education. However, Stone reports research where scaffolding was used with students with learning difficulties and good results were achieved. The first example is the well-known Reciprocal teaching (Palinscar and Brown, 1984), aiming at improving reading comprehension of students with reading difficulties. The effects of Reciprocal teaching are well documented. The second example is the works of Englert and colleagues (Englert, Raphael, Anderson, Anthony, & Stevens, 1991) who used scaffolding principles for writing instruction with good results also for students with learning problems. There are also more recent results from Englert's research on scaffolding writing of students with disabilities (Englert, Zhao, Dunsmore, Callings, & Wollbers, 2007).

Stone (1998) concluded that the examples by Palinscar and Brown (1984) and by Englert and co-workers (1991) show that it is possible to use scaffolding also for students with learning disabilities, but scaffolding must be adjusted to the competence of the learner. Stone emphasised that more research was needed to show which the effective components of scaffolding are, and for what kind of students and what kind of subjects it is suitable. An example of this type of research is the study of Rodgers et al (2016), in which the researchers found that domain contingency (chapter 3.2) was the most effective component of scaffolding.

Tharp and Gallimore (1988) suggested that "assisted performance" should be used instead of scaffolding, and Rogoff (1993, 2003) suggested "apprenticeship" and "participation". Tharp and Gallimore (1988) described means to assist performance: modelling, contingency management, feeding back, instructing, questioning and cognitive structuring, and they described how the learner could be assisted to pass through stages in the ZPD. Feeding-back information on performance is an effective assisting means, and for information to be considered feedback it must be fed to a system which has a standard for performance and a mechanism for comparing performance to the standard (Tharp & Gallimore, 1988).

Stone (1998) found three key notions in his scrutiny of research and theories on scaffolding: a joint task engagement between adult and child, a graduated assistance that varies according to the competence of the child, and transfer of responsibility from adult to child. He concluded that the concept of scaffolding is worth using, because it has a rich history and a good theoretical foundation. But the concept needs some refinement. The concept of scaffolding needs to be invigorated with a more explicit theory of the processes involved in the instilling of new understandings.

3.5 Means and Intentions of Scaffolding: A Framework for Analyses

Van de Pol, Volman and Beishuisen (2010) reviewed research on scaffolding in teacher-student interaction. They found no consensus with respect to the definition of scaffolding, but they found three common core characteristics. The first characteristic is *contingency*, often also referred to as responsiveness or adjusted support. The teacher's support must be adapted to the current level of the student's performance, which means that the student's level of competence must be assessed. The second common characteristic is *fading* or the gradual withdrawal of the scaffolding. The third characteristic, *the transfer of responsibility*, is strongly related to the second meaning. Leith, Yull and Pike (2018) also used the three characteristics, transfer of responsibility, contingency and fading, in their study on self-regulation and other-regulation perspectives to a scaffolded task.

The process by which scaffolding works has been inquired for in earlier reviews (Stone 1998). Van de Pol et al. (2010) made some suggestions about the process: The cognitive load of the learner is reduced with the aid of scaffolding, and this allows the learner to perform parts of a task that he or she would otherwise not be able to perform. Another scaffolding process, also mentioned by Stone (1998), is internalization of the support provided.

Van de Pol et al. (2010) used the six types of functions from Wood et al. (1976) and the six means of assistance from Tharp and Gallimore (1988) to make a framework for analyses. They found that some items described the means of scaffolding or how scaffolding is taking place, and other items referred to the intention or goal of scaffolding or what is scaffolded. They made a system with means and intentions, which they used to analyse research on scaffolding.

The researchers (Van de Pol et al. 2010) found a large group of descriptive studies, mainly in the domain of literacy, which gave rich narratives of scaffolding in the classroom and provided lists of strategies and techniques used by the teachers. Some studies also indicated that scaffolding was effective under certain conditions, but in order to get information about efficacy, the researchers had to find other types of studies. They also found a small group of experimental, quasi-experimental and correlative studies, most of which were on one-to-one tutoring situations. The results of these studies indicated that scaffolding is effective, at least on students' cognitive activities, but the effect on the students' affect was unclear.

To measure scaffolding is difficult, because scaffolding is dynamic, complex and varying, adaptive to the learner and to the topic for learning. The character of scaffolding can vary a lot, depending on the age and the competence of the learner, and depending on the topic. Because the appearance of scaffolding depends so heavily on the context, it is of great importance that the context be specified into great detail (Van de Pol et al. 2010, p 286) Operationalisation of scaffolding is a problem, because there is no consensus with regard to the

conceptualisation of scaffolding, and because there are many different characterisations of scaffolding, there are also many different operationalisations. In a special issue on scaffolding in a journal, the editors (Yull & Carr, 2018) stated that there is no single agreed method of measuring scaffolding.

3.6 Scaffolding and Repair

Repair is a concept which deals with a special kind of scaffolding. Repair means self-corrections in utterances, either to bring one's utterances into line with one's intent, or to make them comprehensible to an interlocutor (Bruner, 1986). Repair is a way for participants in interaction to re-establish and maintain a shared understanding (Schegloff, Jefferson & Sacks, 1977; Schegloff, 1992). The concept of repair is used in conversation analysis (Martin, 2004), and it was also used by Bruner (1986) in analysis of child language. Bruner found "linguistic repairs" in very young children's speech (Bruner, 1986, p 67), and concluded that it showed that some form of metacognition is present at an early age, eighteen months.

The concept "repair" can be used to describe a certain type of scaffolding. Martin (2004, p 187) described repair as scaffolding in the ZDP in her study of learning as interactional change in physiotherapy. Repair occur when there is a misunderstanding or some sort of problem in the communication, and something must be done to remove the problem. The concept of repair is very close to the concept of correction (Martin, 2009), but repair can sometimes occur without the existence of an error (Schegloff et al., 1977).

Repair is comprised of three distinct parts in a repair organisation. The participants orient to a problem or difficulty, make relevant what the problem is and try to solve it. The distinction is between a trouble source, the repair initiation and the repair itself. A repair organisation can vary in four ways: self-initiated self-repair, other-initiated self-repair, self-initiated other-repair and other-initiated other-repair (Schegloff, et al., 1977; Schegloff, 1992). Self-initiation and self-repair are more frequent and preferred in conversations in daily life, and other-initiation and other-repair are more frequent in adult-child conversations (Schegloff, et al., 1977, p 381). Other-initiated repair is more frequent also in instructional contexts.

Martin (2004, 2009) described a learning process, where a change happened from other- initiation to self-initiation, and from other-repair to self-repair. She also found examples of "assisted self-repair" (Martin, 2004, pp 101-104) or, with another concept, "collaborative completion" (Martin, 2004, p 104). Assisted self-repair was usually an intermediate stage between other-repair or self-repair.

The development of repair organisation in stages resembles the two first stages of assisted performance in the scheme of Tharp and Gallimore (1988).

Four stages of the ZDP according to Tharp and Gallimore :

1. Performance assisted by others, implicit and explicit mediation
2. Performance assisted by self, self-regulation
3. Performance is automatized
4. Recursion back through the ZDP, to self-regulation

3.7 Conclusion: Core Characteristics of Scaffolding

The original definition of scaffolding (Wood et al, 1976) is a process “that enables a child or a novice to solve a task or achieve a goal that would be beyond his unassisted efforts.” Scaffolding is a dynamic concept, and it is difficult to find a more precise and more comprehensive definition, valid in all circumstances, and there are many various ways to operationalise scaffolding (van de Pol et al, 2010). However, there are some characteristics of scaffolding, which are shared by many authors, and which give a clear description of the concept.

A joint task engagement is essential, with both the child and the adult actively working to a common goal in a collaborative way. The learner’s own intentions should be the aim of the process (Masters & Yelland, 2002; Stone, 1998). The spontaneous actions of the child in problem-solving should be considered in planning the process of scaffolding (Yelland & Masters, 2007).

The support given to the learner is contingent, which means that the support is adapted and adjusted to the competence of the learner and to the task (van de Pol et al, 2010; Stone, 1998). The teacher must know the competence of the learner, by diagnosing or by observing the learner’s work. Scaffolding reading and writing is therefore best performed in a one-to-one situation, and more difficult even in a small group (Hoschbaum, Peters & Sylva, 1996; Rodgers, 2004).

Scaffolding is gradually withdrawn, faded away, when the learner does not need it any longer, and the responsibility is transferred from the teacher to the learner (Stone, 1998; van de Pol et al, 2010). If the task develops to a higher level of difficulty, such as writing of self-generated texts during a period of time, or reading of more difficult texts, scaffolding is not withdrawn, but it is modulated to happen on a higher level (Hoschbaum et al, 1996).

Scaffolding is usually a strategy which the teacher implements in order to support a learner, but it can also be a tool, a scaffolding device such as a cue card or an application on an iPad provided for the learner (Yelland & Masters, 2007).

In my study, the children use auditory feedback as a scaffold for their writing. The teacher scaffolds the children’s writing by helping them to use auditory feedback and by supporting their writing in other ways when it is needed, depending on the task and on the level of the children’s literacy skills.

4 Speech Synthesis as an Aid for Literacy Learning

This chapter reports research on speech synthesis used to support learning to read and write, and besides that research on speech synthesis used to support reading and writing as a compensation for weak skills. The border between an aid for learning and an aid for compensation, assistive technology, is very difficult to draw. Much of the assistive technology is generic and therefore useful for individuals with a range of abilities, and the use of assistive technology can also enhance learning (Maor, Currie & Drewry, 2011).

Computer-based speech feedback received relatively wide popularity among researchers in the nineties, both with synthetic (Elbro, Rasmussen & Spelling 1996; Olson & Wise 1992; Olofsson 1992; Wise & Olson 1992,) and digitized, recorded, (van Daal & Reitsma, 2000) speech. The results of the studies were promising, inspired to develop new types of educative programs with speech feedback and to use synthetic speech to compensate for reading difficulties. The US National Reading Panel (NIHD 2000) mentioned especially the addition of speech to print as a promising alternative.

4.1 Description of Speech Synthesis

Speech synthesis is the artificial production of human speech as a computer-generated simulation. A computer system used for this purpose, a speech synthesizer, can be implemented in software or hardware products. A text-to-speech system converts written language into speech.

A Swedish speech synthesizer, or speech machine, was constructed by Fant and his research group at the Royal Institute of Technology in the nineteen fifties. The device was called Ove (Fant, 1985), because the machine could produce the vowels “o” and “e”, and when the sounds were pronounced very close to each other, it sounded almost like the name “Ove”. When the third version of Ove appeared in 1967, the most remarkable improvement was that it was controlled by a computer (Liljenkrants, 1968). After further development the speech synthesizer, now called SA101, began to be commercially used in the eighties (Magnusson, Blomberg, Carlson, Elenius, & Granström, 1984). The speech synthesizer built on formant synthesis.

The two primary technologies generating synthetic speech waveforms were concatenative synthesis and formant synthesis (Allen, Hunnicut, & Klatt, 1987). Concatenative synthesis was based on the concatenation or stringing together of segments of recorded speech. Generally, concatenative synthesis produced the most natural-sounding synthesized speech, but sometimes problems with intelligibility appeared.

Formant synthesis did not use human speech sample at runtime. Instead, the synthesized speech was created using additive synthesis and an acoustic model. Parameters such as fundamental frequency, voicing, and noise levels were varied over time to create a waveform of artificial speech. Formant-synthesized speech

was more intelligible, but it sounded artificial and robot-like in the first versions.

Speech synthesis was very soon used to read texts aloud for persons with visual impairment (Granström, 1987), and as a communication aid for persons with speech problems (Magnusson, Blomberg, Carlson, Elenius, & Granström, 1984). Synthetic speech was also soon used in training equipment for children with reading and writing difficulties (Fant, 1985). Dahl and Galyas (1987) developed a text processing program with speech synthesis and training programs for reading and writing, and they named their programs after the early speech synthesizer called Ove. Dahl (1997) studied how children and their teachers worked with the training programs, and found positive effects, especially on the children's motivation and self-esteem.

4.2 Research on Speech Synthesis to Support Reading

Practice of reading meaningful texts has been shown to contribute to the development of accurate and fluent reading. Reading texts on the computer with speech support may be an effective way to provide supported practice for students with difficulties to read books and texts in the usual way (MacArthur, 2013).

The story-reading studies of Olson and Wise (1992; Wise & Olson, 1992) were one of the earliest studies of speech feedback in reading instruction for children with reading difficulties. Olson and Wise wanted to give children with reading difficulties the same possibility of exposure to print as their classmates. They let young school children read stories on the computer screen, and the children could order speech feedback from synthetic speech on difficult words. The speech feedback was given with a whole word, divided into syllables or into onset/rhyme. The researchers used synthetic speech instead of digitized, recorded, speech, although the quality of synthetic speech was not so good in those days, because they wanted to choose texts more freely according to the children's interests. Olson and Wise and their colleagues are a research group which has done much work on reading with computerized speech feedback.

Olson and Wise (1992) found that the children in the training groups performed better in a word reading test than their untrained controls. The different kinds of speech feedback did not affect the result, a conclusion that Elbro et al. (1996) also made from their research. Their training groups did not improve spelling, although they also used a program constructed to show the relation between language sounds and letters and letter combinations. The researchers concluded that in order to improve spelling, it would be necessary to include writing in the training conditions.

A problem was that the children seldom requested feed-back for difficult words. The researcher included comprehension questions in the texts to check reading, and tutors were present during some lessons to teach and encourage the children to seek help from speech feed-back when they needed it. If children were trained to ask for help, reading with speech feed-back had effect on reading

skills.

When the researchers combined speech feed-back on computer-supported reading with other kinds of instruction in reading skills on the computer, and also with teacher instruction, the positive effect on reading achievement was more considerable. The researcher noticed that children with the lowest initial phonological skills did not make much progress. These children needed more phonological instruction before they could benefit from reading with speech feed-back (Olson & Wise 2006; Wise, Ring & Olson 2000).

In a Swedish study (Johansson 2010) flash-cards were used to enhance reading fluency with a group of “poor readers” aged 11 and 17. A word was presented with speech synthesis and with a short exposure on the screen, and the response was to spell the word. Feedback from speech synthesis could be used during spelling the word. The research persons usually used interactive feed-back rather sparsely, with some exceptions. Johansson found that her research persons made significant progress in reading fluency during a training period of three to four months, and that their progress was greater than what average students usually develop during the same time. Johansson’s study is partly a replication of studies in the Netherlands (van Daal & Reitsma, 2000).

Fasting and Halaas Lyster (2005) evaluated a computer program with synthetic speech feed-back designed to assist reading. The children could choose the texts they wanted to read, and an individual adaptation of text appearance on screen and auditory-visual reading support was made. A text-to-speech component was available to read aloud difficult words, lines or sentences at the pupil’s request. Word and sentences could be highlighted to help the pupil to “keep-on-track” while reading, and each word was simultaneously highlighted when the text-to-speech feature was used. A text editor was available to summarise or to write new texts, and synthetic speech could be used to support writing.

After a training period with at least 20 minutes a day for seven weeks, the experimental group had gained more in word reading, sentence reading and spelling than the control group. The children in the experimental group and in the control group were “struggling readers”, according to their teachers’ view and test results. The control group had no special intervention, only ordinary teaching.

Detailed analyses of the impact of the synthetic speech program component on pupils’ growth in reading and spelling were carried out in the experimental group. The analyses showed a significant impact of the synthetic speech on the sentence reading task and on the spelling task. The analyses also showed that the pupils with poorer growth in their abilities seemed to benefit most from the use of synthetic speech. On the other hand, the more the pupils increased their reading skills, the less they needed synthetic speech assistance.

Noteworthy is, that the reading program in the study of Fasting and Halaas Lyster had effect on spelling. In early story-reading studies (Elbro, Rasmussen & Spelling, 1995; Olson & Wise, 1992), no effect on spelling was found. The explanation is probably that the children in the study of Fasting and Halaas

Lyster (2005) also could write texts with speech feed-back, and they had a more active condition for learning to spell.

4.3 Research on Speech Synthesis to Support Writing

Technology applications, among them speech synthesis, have the potential to support struggling writers by compensating for difficulties in transcription, helping to manage planning and revising processes, and enhancing motivation to write (MacArthur 2013). The US National Commission on Writing (2003) suggested that new technologies could advance both the teaching and learning of writing, and they recommended more research. However, relatively little new research has been reported on writing and technology for struggling writers (MacArthur 2013).

The early researchers Wise & Olson (1992) let a group of children write words with auditory feed-back, and after that write words which resembled the trained words. Another group of children also wrote words, but with only visual feedback. The group that had written words with auditory feedback often spelled the words more correctly than the other group, but not always, so the results were mixed.

DeMott Painter (2002) made a case study of two boys in fifth grade with learning disabilities using Text-to-Speech and Word Predict Programs to compose texts during a school year. The boys listened to the words they wrote, and they rewrote words many times until the words were pronounced correctly by the synthetic speech. The boys made progress in their writing during the year, although sometimes there were problems with the synthetic speech. Sometimes a wrongly spelled word sounded quite good when it was pronounced, and sometimes long words were not correctly pronounced even if they were correctly spelled.

Hyltefors Nyström (2011) made a study with six children who wrote letters and short words with a “talking keyboard” during a period of three weeks, 15-20 minutes per day. The children, one girl and five boys, were in the first and second grade in a class for children with language difficulties, and they were about seven and eight years old. They used a computer game with falling letters, and they got short words to copy, with speech feed-back. The children’s letter knowledge and word reading improved. The researcher mentioned that the children were very much amused, when they noticed from the speech feed-back that they were writing real words. Sometimes, when there was extra time when the training program was finished, the children could write what they wanted in a word document with speech feed-back. They wrote their own names, short words and letter combinations, and they laughed a lot when the speech synthesis pronounced their writings.

The two case studies above gave a vivid description of the use of speech synthesis for children’s writing, and they pointed out some problems and some benefits. As they had no control groups, no comparisons could be made with other groups of children with other types of stimulation for their writing

development.

With cheaper hardware and software, and more advanced technology, computers in schools could be equipped with speech synthesis programs and talking keyboards. Writing-to-read programs (Trageton, 2005), where children started their learning to read and write with writing on a computer, had been used before, but now speech synthesis was added. Hultin and Westman (2013; 2014) described a school development project, *Learning to read through writing on computers*, where a group of 30 primary school teachers in the first grade in a Swedish municipality used digital tools for early literacy teaching. The children listened to feed-back from synthetic speech in their headphones when they wrote words and text.

Hultin and Westman (2013, 2014) report that teaching changed from a phonics-oriented approach to a text production approach. However, according to Hultin and Westman, phonics and sounding out are integrated in the writing process through the speech synthesis and the talking keyboard. As soon as the children press a key, they, in their headphones, can listen to the sound of the letter they are writing. Thus, sounding out is always present in their writing (2013, p 108). Speech synthesis was also used to correct the text afterwards. When the children listened to their texts, they could notice words that were not as they had intended, and could correct them (Hultin & Westman, 2014, p 118). Thus, the children had more control over their own writing, and could do some revising.

Hultin and Westman (2013; 2014) found that the children wrote longer and more varied texts than children in conventional teaching groups did. The texts represented more different kinds of genres. The teachers in the project reported that learning to read happened faster in the project groups, and that the numbers of children with reading and writing disabilities decreased. A teacher in their project also mentioned (Wiklander, 2014) that the children did not mix up letters like and <d>, <k> and <g>, as they used to do with conventional teaching. However, no research was done to verify these observations. The main interest of the researchers was on text genres. The use of speech feedback from synthetic speech was not focus of the study.

Agélii Genlott and Grönlund (2013) developed the teaching project *Integrated Write to Read, iWTR*. "Integrated" means that reading and writing were integrated in a social learning process. The aim was to make literacy learning easier by separating the cognitive process of learning to read from the motor process of handwriting. Children cooperated in pairs producing texts, using keyboards, which were published on a class web site. The computers were equipped with speech synthesis.

The researchers mention that the children used speech synthesis to check that their writing produced the right sound, and thus they got a direct response to their spelling. With the use of speech synthesis also the children who were not yet able to read, could participate in all kinds of communication between the classmates by using speech technology to read the different texts, and they were also able to write feedback to their classmates. Using keyboard and speech

synthesis, every student could participate in communication and be visible and read on the web.

The researchers compared two first grade classes in a Swedish school which had their literacy teaching in the iWTR-project with two first grade classes in the same school with conventional literacy teaching. The children in the project classes had slightly better results in a reading test after the first school year. They had clearly better results in writing, and they wrote longer texts with better structure, clearer content and more elaborate language. The study was only a small-scale pilot study, and the comparison groups had no corresponding type of intervention, so the results can of course not be generalised.

Agelii Genlott and Grönlund emphasised the importance of social interaction when ICT tools are used for learning. They stated that “the effect of ICT tools is mediated through ‘the right use’, i.e. the setup of the social interaction in which the tool is used. The tool itself has no direct influence on learning but lends itself to both positive and negative outcomes depending on how it is used” (Agelii Genlott & Grönlund, 2013, p 99).

In her report on a Writing-to-Read project, *ASL*, in Uppsala, Sweden, Liberg (2014) studied two classes where most of the writing during the first two years was made with a word processing program with speech synthesis. Liberg stated that the children from the start learned the letters in a functional context when they wrote their own texts. The children had immediate response from speech synthesis on the letters they wrote and on their spelling of words. All the children broke the alphabetic code during the first year, and they moved relatively fast forward in their learning to read and write. Liberg made no comparison of the results with other classes where writing was done in a more traditional way.

In Norway, Writing-to-Read with speech synthesis has been used in first and second grade in primary school under the name *STL+* (Finne, Roås & Kjolholdt, 2014). The authors stated that the children in a class with *STL+* in the first grade had better results in letter writing than the control group. A group of children with very low results at the start, made great achievements both in writing of words and reading of non-words, and performed even better than the control group. Writing-to-Read with speech synthesis seemed to enhance literacy development most for those children who had the weakest results in the start. The frequent repetitions of the letters and their sounds from speech synthesis could have been one reason for the positive development (Finne et al 2014, p 35). The authors also emphasise the functionality of the use of letters: words are made up of letters, and the words are put together to texts, which are meaningful for the children.

4.4 Speech Synthesis as Assistive Technology

Speech synthesis is used both as a tool for stimulating learning to read and write and as an aid to compensate for problems with reading and writing, in Assistive Technology. The term Assistive Technology, AT, is generic and used to describe

assistive, adaptive and rehabilitative devices for people with varying degrees of disability. Essentially, these technologies are aimed at assisting or expanding human function or capabilities (Maor, Currie & Drewry, 2011). The border between assistive technology and technology used to stimulate learning is not very clear.

Text-to-speech programs usually have a compensatory effect both on reading comprehension and reading rate, but the gains vary between groups of readers (Grunér, Östberg & Hedenius, 2018). Students with lower reading skill usually gain more from text-to-speech, the influence varies between age groups, and some students even have lower results in reading rate and reading comprehension with text-to-speech. Grunér and her co-workers studied students with reading difficulties. They found that younger students, grades 3-5, gained in reading comprehension, but not older students, grades 6-9. All participants gained in reading rate. Grunér and her colleagues also studied the relation with their students' result on an attention-deficit scale. They found that younger students with ADHD symptoms did not gain so much from text-to-speech in reading comprehension, but older students with ADHD symptoms gained more (Grunér et al., 2018).

Strong compensatory effects on reading were found when synthetic speech was used with a "reading pen" with optical character recognition (Higgins & Raskind, 2005). A word or a line could be scanned with the device, after some seconds the words appeared on the small display and were read aloud by a built-in speech synthesizer. A group of students got a significantly higher score on a reading comprehension test when they read texts and used the "pen" when they had difficulties to read a word. The "reading pen" was easy to use with an ordinary school- book or any other book, and unlike when an ordinary speech synthesis is used, the text need not be digital.

Speech synthesis is often used together with spell checkers and word prediction. Fitzgerald, Koury and Mitchem (2008) in their review mentioned compensatory effects on writing with spell checkers and speech synthesis. If the spell checker offered no option to the writer, speech synthesis was more successful in aiding spelling correction. Word processing with speech synthesis and word prediction was studied (MacArthur, 1998, 2009) in a case study with five students, ages 9 and 10, with severe writing problems. The students wrote dialogue journals to their teacher, written conversations between the teacher and each individual student. Four of the students benefitted from word processing with speech synthesis and word prediction compared to writing on an ordinary word processor. The proportion of correctly spelled words and legible words rose considerably when the students used word prediction and could check their writing with speech synthesis.

Cullen, Richards and Frank (2008) studied what effect the use of a talking word processor had on writing, independently, and in combination with word prediction software. Seven students with special needs used a talking word processor with synthetic speech and spell checker software for journal writing, and after that they used the talking word processor in conjunction with word

prediction software. With the talking word processor, the group mean for the number of misspellings decreased, accuracy percentage and number of words increased, and even more in combination with word prediction. However, the software had different benefits for different students, and the students expressed preferences for the particular functions of software.

Assistive technology like spell checkers, text-to-speech, and speech recognition programs are now accessible for smart phones and tablets, and the programs are relatively cheap and easy to handle. Fälth and Svensson (2015) studied how a multifunctional application for iPhone/iPad, an optical character recognition reader with built-in speech synthesis, was used as a compensatory program for students with reading and writing difficulties in fifth grade. They found that the students rapidly learned how to use the application, and that it provided good assistance in their reading. The compensatory program also seemed to give transfer effects on word decoding, tested with Jacobson's word chain test. Although the number of participants in the study was relatively small, 12 children, only one test was used to measure the gain, and the study needs replication, the result is interesting. The use of speech synthesis for compensation seemed to stimulate learning, to enhance word decoding skills.

Svensson and his colleagues found in a study with more research persons and a control group that Text-to-Speech used as an assistive tool also could improve reading skills (Svensson et al., 2019). Children with severe reading difficulties used Text-to-Speech and other assistive tools as applications on tablets during all their reading and writing lessons for a period. Their reading skills improved as much as the reading skills of the control group, which had traditional reading and writing lessons, also with special training of the connection between speech sounds and letters. The children with the greatest difficulties benefitted most of the assistive tools, and many children reported higher motivation for reading and for schoolwork generally.

White and Robertson (2015) studied teacher and student co-learning in a specialised program with assistive technology, such as speech synthesis to support reading, and speech-to-text to support writing. The participants were five children with reading difficulties, 8-10 years, and two teachers. The researchers and the teachers collaborated intensely with weekly discussions on student progress and program arrangements. After the research period the students had gained measurably in reading fluency, reading comprehension and engagement for studies. The authors emphasised that close collaboration between teachers and researchers was important to make the program effective. With assistive technology, the children could keep pace with their classmates, and they became more motivated for schoolwork and studies generally.

Students sometimes do not want to use assistive technology devices because they look different than ordinary computers and tablets, and students can feel stigmatised if they use them (Foley & Ferri, 2012). However, synthetic speech and other products like predictive spell-checkers and computer touch screens, were first designed specifically for people with disabilities in mind, but they have done a crossover to mainstream and are commonly used.

The increasing proliferation of mobile devices that connect to the internet and the development of applications have an impact on general education (European Agency for Development in Special Needs Education, 2013), and synthetic speech is used in many apps that support reading and text composing (Reid et al., 2013). It is usually more motivating for a student with difficulties in reading and writing to use a product like a tablet computer with apps or a smart telephone, products that are clearly mainstream and easy to use.

4.5 Conclusion

Different kinds of research are gathered in this chapter, experimental quantitative studies, and studies of qualitative nature, many of them case studies. Some studies are peer reviewed articles, and some are reports from research projects. A problem for research on the use of speech synthesis in literacy learning, and for all other research on the use of technology applications in teaching, is that it is impossible to keep up pace with the fast development of technology (MacArthur, 2013). When research is reported, equipment and programs which have been used are often out of date. There is not yet much research published on the use of new mobile technology. The basic principles for speech synthesis as an aid for reading and writing are the same in the modern applications as in the early research of Olson and Wise and their colleagues (1992), but tablets with applications are easier to use and easier to take to the classroom, and the quality of speech is better in newer devices.

SBU, the Swedish Council on Health Technology Assessment, whose purpose is to assess health care inventions, could not give any recommendations for using assistive tools in training and compensating for reading and writing problems because of the lack of scientific evidence (SBU 2014), especially because of the lack of studies with control groups. Another problem is that when a researcher tries out equipment, a computer program or a teaching method, which he or she has developed or is related to in other ways, the results will often turn out positively (Abbot, 2007). With the background of these problems, small studies are also valuable (Svensson, 2015). Small studies can give a vivid description of what happens when children use speech synthesis as a tool for their reading and writing. Generally, it is difficult to find detailed descriptions of what the children do, what is difficult for them, and how their literacy development progresses when they use feedback from speech synthesis.

Several studies show that progress in spelling and writing does not happen automatically as a result of work on texts with speech feedback (Fasting & Halaas Lyster, 2005; Olson & Wise, 1992), and it seems that spelling and writing need to be actively performed to result in progress.

Some studies report that support from the teacher is important when children write with speech synthesis (Wise, Ring, & Olson, 2000), and that the role of the teacher in relation to the use of technology generally has a considerable impact on the effect of the contribution (Archer, Savage, Sanghera-

Sidhu, Wood, Gottardo, & Chen, 2014; Svensson, 2015; Taube et al., 2015). Detailed descriptions of how the teacher is supporting the children in their writing with speech synthesis are not so easy to find in research reports. Because of the teacher's important role for learning benefits from speech feed-back and technology applications generally, it is valuable to have descriptions of interaction between teacher and learner in this area.

Many studies report that the use of auditory feed-back from speech synthesis benefit learners with difficulties in reading and writing most (Fasting & Halaas Lyster, 2005; Finne et al., 2014; Grunér et al., 2017). More research about how struggling readers and writers can use speech synthesis in their learning is motivated.

More research is about speech synthesis as an aid for reading than as an aid for writing (MacArthur, 2013), and more research is about speech synthesis in assistive technology than as a tool for learning. Therefore, more research is needed about how speech synthesis can be used as an aid in learning and training spelling and writing.

5 Methodological Considerations

The research approach of this study is multiple-case study. After a presentation of aims and research questions, the characteristics of case study and how they relate to my study will be discussed. The design of the study, source of evidence, data collection instruments and analysis procedures are presented after that, and the quality of the research is considered.

A pre-work for this study was my licentiate thesis (Hannus-Gullmets, 1999). I studied if Swedish-speaking children in Finland could use the Swedish speech synthesis SA201 and the program Ove (Dahl, 1997), and the result was that the children could understand and use the Swedish speech synthesis, except a few words. I also tried to study how auditory feedback from speech synthesis could be used to train children's skills in reading and writing. The study had a mixed method design (Johnson & Onwuegbuzie, 2004) with tests, interviews and observations.

During my work with the material for the licentiate thesis I noticed, that the observations of children writing texts with auditory feedback gave a picture of the difficulties they had with their spelling, how they listened to feedback and worked with words. I got the idea to make a case study, in which I during a longer time could follow the children's work and the development of their writing, and how the teacher assisted them.

5.1 Aim and Research Questions

The actual study follows four children's writing during five months in each case. Development in reading and writing skills and the use of auditory feedback are studied during that period. The participating children in the study were "struggling readers and writers".

The overarching aim of the study is to increase knowledge of literacy skills development when writing is scaffolded by auditory feedback from speech synthesis. The specific aim of the study is twofold: to follow literacy learning during a period of text-writing with auditory feedback from speech synthesis, and to study the process of scaffolding, which means how children use auditory feedback as a scaffold for their writing and how the teacher scaffolds the children's work.

The aim was pursued based on the following research questions:

1. How are the literacy skills of the participating children developing during the period?
2. How do the children make use of auditory feedback as a scaffold for their writing?
3. How does the teacher scaffold the children's writing?

The literacy skills which this study investigates are knowledge of letters, perception of speech sounds, reading and spelling of single words, construction

of sentences, use of punctuation marks, writing of stories and development of willingness to write.

Scaffolding is investigated in relation to the classic formulation of the concept (Wood et al., 1986) and to the later development of the concept (Martin, 2004, van de Pol et al., 2010,). The children use auditory feedback as a scaffold for their writing, and the teacher scaffolds the children's writing by helping them to use auditory feedback and by supporting their writing in other ways when it is needed, depending on the task and on the level of the children's literacy skills.

5.2 Case Study as a Research Approach

The research approach of the actual study is case study. Criteria for case study as a formal research approach are formed by Yin (1994, 2009, 2014) Merriam (1988, 2009) and Stake (1995), among others. Case study has a long tradition in the history of social sciences, of psychology and of education, but earlier it was sometimes criticized for not having any meaningful criteria for its use, and for being nothing but a method for data collection or for teaching. Nowadays case study is usually seen as methodology and as a type of design in qualitative research (Creswell, 2013).

5.2.1 The object of study: a phenomenon with border

The main characteristic of case study is that the object of study, the case, is a phenomenon with borders. According to Merriam (2009) a case study is an examination of a specific phenomenon such as a program, an event, a person, a process, an institution or a social group. It is the unit of analysis – a bounded system – that determines whether a study is a case study (Merriam, 2009, p. 42). Stake (1995) characterises a case as an integrated system, which has a boundary and working parts. Yin (2009, preface) declares that the “case” is a concrete entity, event, occurrence, action, but not an abstract topic as a concept, argument, hypothesis or theory.

My study concerns a teaching project, a period of text-writing with a certain method, namely writing texts on a computer with auditory feed-back from speech synthesis, and with certain principles for how the teacher should help the children with their writing. The project period has a date for the starting point and for the ending point of each case. The process has clear borders in time and place, a lesson once or twice a week in a certain room in the children's school. The purpose of the teaching project was to enhance the participating children's progress in reading and writing. There was a plan for the teacher's work during the project (chapter 5.3.2).

The definition of the case, the unit of analysis, is a fundamental issue in a case study. Yin links the definition of the unit of analysis to the research questions. “Your ...definition of the unit of analysis (which is the same as the definition of the “case”) is related to the way you have defined your initial research questions”

(Yin 1994, p. 22, 2009, p. 30). Merriam (2009, pp 41) explains that “the unit of analysis, not the topic of investigation, characterises a case study”.

My unit of analysis, the case, is the teaching project which I have described above. The study is a multiple-case study with four cases: four periods of text-writing with four children.

A multiple-case design means that the same study contains more than one single case. The evidence from multiple cases is often considered more compelling, and the overall study is therefore regarded as being more robust. The disadvantage of a multiple-case design is that it can require extensive resources and time beyond the means of a single student or independent research investigator (Yin, 1994, p. 45, 2009, p. 53). Merriam (2009, pp 49-50) uses the concept “multisite case studies”, and she declares that the inclusion of multiple cases is a common strategy for enhancing the external validity or the generalizability of the findings. According to Yin (1994, 2009, 2014), a multiple-case study is guided by replication logic and not by sampling logic. The generalization from a case study can be done to a theoretical framework and not to a population. The results from multiple cases can be looked upon as replications of a finding, much in the same way as a replication of an experiment. The cases must be carefully selected with regards to the theoretical framework.

5.2.2 Characteristics of case study as a research approach

Yin’s definition of case studies as a comprehensive research strategy consists of two parts:

“1. A case study is an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident.

2. The case study inquiry copes with the technically distinctive situations in which there will be many more variables of interest than data points, and as one result relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result benefits from the prior development of theoretical propositions to guide data collection and analysis” (Yin, 2009, p. 18; Yin, 2014, pp. 16-17).

Yin’s definition stresses some characteristics of case study methodology, which make it suitable for my research and my research questions:

Phenomenon and context are intertwined

According to Yin’s (1994, 2009, 2014) definition, a case study “investigates a contemporary phenomenon especially when the boundaries between phenomenon and context are not clearly evident”. Case study can be used when the phenomenon cannot be understood without investigating the most important contextual conditions. Stake (1995) mentions the same characteristic in his description of case studies as holistic, empirical, interpretive and emphatic, where “holistic” means that the researcher should consider the interrelationship between the phenomenon and its context.

In my study, when I follow the development of the participating children’s literacy skills during the teaching period, it is not possible to isolate the progress

in reading and writing that this activity had led to from the influence of everything else that have happened in their school and in their spare time.

Multiple sources

A characteristic feature of case study is that evidence is gathered from different kinds of sources. Yin (1994, 2009, 2014) declares that a case study relies on multiple sources of evidence with data needing to converge in a triangulating fashion, because phenomenon and context are not always distinguishable in real-life situations. That means that in a case study there will be many more variables of interests than data points. Yin mentions six main sources of evidence, documentation, archival records, interviews, direct observations, participant observation and physical artefacts, and other sources of evidence, for example psychological testing (1994, pp. 79-80, 2009, p.101). Merriam (1988, p. 10; 2009 p. 42) states that case study does not claim any special method for data collection and data analysis. Any and all methods of gathering data from testing to interviewing can be used.

In my study, the sources of evidence are participant observation, documentation and psychological testing.

Theoretical framework

According to Yin (2009, pp 39-40) a theoretical framework is necessary for a case study, and theoretical propositions should be made if possible. In this respect a case study differs from ethnography and grounded theory. A complete research design for a case study requires the development of a theoretical framework, and the research in a case study is guided by the research questions and by the theoretical propositions, if there are propositions. The generalization of the findings in case study happens in relation to theoretical framework as an analytic, not as a statistical generalization. Merriam (2009) declares that a theoretical framework is necessary for all kinds of qualitative research, and she makes no special claims on theory for case studies.

The theoretical framework for my study is the concept of scaffolding (Wood et al. 1976; Bruner, 1986) and its functions, means and intentions (van de Pol, 2010; Stakes, 1998; Tharp & Gallimore, 1988). In my pre-study (Hannus-Gullmets, 1999) I tried to describe how scaffolding happened in interaction between student and teacher using speech synthesis as an aid in writing.

The goal of scaffolding in the teaching project was to help the children to write words and texts and enhance their learning of literacy skills in that way. The theoretical framework is the theory of phonological and phonemic awareness as an important element in early literacy (Høien & Lundberg, 2000; Stanovich, Cunningham, & Cramer, 1984; Vellutino et al., 2004). The theory motivates the use of auditory feed-back to help the children analyse words and find speech sounds, phonemes and morphemes. The children in my study wrote the words that they wanted to write, and they wrote self-generated texts. Berninger's theory of developing writing (Berninger, 2009, Berninger & Abbot, 2010, Berninger & Winn, 2006) as text generation, transcription and executive function is a framework for my thinking about the children's work.

Type of research questions, events over time

According to Yin (1994, 2009), the type of research questions has an important role in the choice of research approach. When the research questions are “how” questions, case study has a distinct advantage if the investigator does not have the control of the events which an experiment requires. “How” and “why” questions demand an analysis over time, “because such questions deal with operational links needing to be traced over time, rather than mere frequencies or incidence” (Yin, 1994, 2009). A major strength of case studies is the ability to trace changes over time, because case studies are not limited to cross-sectional or static assessments of a particular situation. According to Yin, some type of time-series analysis always may be possible, if the events over time have been traced in detail and with precision. Merriam (2009) also mentions that case studies often are longitudinal.

The research questions in my study are “how” questions, which is suitable for case study. Each case in my study covers five months, so it is possible to trace changes during a space of time.

Rich description, investigation in depth

Merriam (2009, p. 43) characterises the result of a case study as a rich, “thick” description of the phenomenon under study. A thick description means a complete, literal description of the incident or entity being investigated. Yin, in the fourth edition of his book, *Case Study Research*, (2009, p. 18) included “in depth” in his definition: “A case study is an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context”.

The result of my study is a detailed, long and comprehensive description of each case, which is in accordance with the demand for a rich and thick description.

5.2.3 Participant observation as a source of evidence

In my study, participant observation is an important source, because the researcher also acts as the teacher in the lessons in writing with auditory feedback. Yin states that participant observation provides certain unusual opportunities for collecting case study data, but that it also involves major problems (Yin 1994, pp 87-89; 2009, pp 111-113).

The most distinctive opportunity according to Yin (1994, 2009) is that participant observation can make it possible to gain access to events and groups that would otherwise be inaccessible to scientific investigation. Sometimes there may not be any other way of collecting evidence than through participant observation. My study had been difficult to do with any other method than participant observation. It would have been difficult to find a teacher willing to do the job with the lessons during such a long time.

Another big opportunity is that participant observation makes it possible to perceive reality from the viewpoint of someone “inside” the case study rather than external to it (Yin 1994, 2009). The researcher may also have ability to manipulate minor events which can produce a greater variety of situations for the purposes of collecting data.

According to Cohen and Manion (1994, pp110-111) participant as well as non-participant observation has the advantage that data can be collected of non-verbal behaviour. The investigator can discern ongoing behaviour as it occurs and is able to make appropriate notes about its salient features. An interesting remark from Cohen and Manion is that case study observations are less reactive than other types of data-gathering methods. For example, in laboratory-based experiments and in surveys that depend upon verbal responses to structured questions, bias can be introduced in the very data that researchers are attempting to study.

As Yin (1994, 2009) declared, participant observation also involves major problems. The participant role may simply require too much attention relative to the observer role. The participant-observer may not have time enough to take notes or to raise questions about events from different perspectives. This problem was also noticed in my study.

A difficult problem with participant observation has to do with bias. A close relationship may develop between the researcher and the research persons, which can influence the course of events. The participant-observer can even become a supporter of the group or organisation. Cohen and Manion (1994) declare that results from participant observation can be criticized for being subjective, biased, impressionistic and idiosyncratic. Merriam (2009, p 126) describes participant observation as a schizophrenic activity in that the researcher usually participates but not to the extent of becoming totally absorbed in the activity. She concludes that this is a problem not easily dealt with, but the researcher should at least be conscious about the matter.

5.2.4 Documentation as a source of evidence

Documentation, in the shape of keystroke logs and videotapes, is another source of evidence in my study. Logging of keystrokes happened automatically in the Ove program. The video camera was fixed on a stand, and the teacher/researcher did not need to operate the camera during lessons. According to Yin (1994, 2014) the most important use of documents is to corroborate and augment, or contradict, evidence from other sources. Yin mentions letters, e-mails and news clippings as examples of documents. The logs and the videotapes in my study are made without the researcher's active operation, and I look upon them as documentation. The texts which the children wrote and printed out are another type of documentation. There is a description of the psychological tests in chapter 5.4.3.

5.3 Design of the Study

My study is a multiple-case study with four cases, four periods of a teaching project. The sources of evidence are participant observation, documentation and assessment reports. An overview of the design of the study can be found in Table 1.

5.3.1 Unit of analysis, the teaching project.

My unit of analysis is the case, the teaching project. It was accomplished in a compulsory nine-year school for Swedish-speaking children in a middle-sized town in Finland. Four children, who were “struggling readers and writers”, were chosen to participate. The purpose of the teaching project was to give the children extra training in writing, and to help them to improve their skills in reading and writing. Another idea with the project was to try out speech synthesis as an aid for writing.

The children came once or twice a week to the special education teacher’s room, and they wrote words and texts on the computer with auditory feedback. The children chose themselves what words they wanted to write and what stories they wanted to compose.

The teacher supported the children in finding something to write about, and she helped with the writing if needed. The guideline for the teacher’s activity was to help the child when he really needed help, but not to help too much. The child should have the opportunity to write the word, to listen to the feedback from speech synthesis to make a judgement of the spelling. The child should be allowed to try out how to write the words, but the teacher should help if the task was too difficult. The guidelines for the teacher were made on basis of experiences from the pre-study (Hannus-Gullmets 1999).

The researcher was the teacher in the lessons and did participant observation with the problems and the possibilities which that means (5.2.3). The teacher/researcher took field notes during all the lessons. There were about twenty lessons of approximately half an hour during a period of five months for each child.

Table 1. Overview of the design of the study

RQ	Source of evidence	Instrument	Analysis
RQ 1 Literacy skills development	Participant observation	Field notes	“Thick” description, comparison of cases
	Documentation	Video Log, keystrokes Printed text	Comparison of test results and results from field notes and videos
	Assessment report	Umesol NEPSY Raven	
RQ 2 Use of Auditory feed-back	Participant observation Documentation	Field notes Video, Log of keystrokes	“Thick” description, comparison of cases
RQ 3 Scaffolding	Documentation Participant obs.	Video, Field notes, Log of keystrokes	“Thick” description, comparison of cases

5.3.2 Participants

Four children, all boys, were chosen to participate after discussions with their class teacher and their special education teacher. The first criterion was that their teachers judged the children to have difficulties in reading and writing and to need some extra training. The children were “struggling readers and writers”. For the youngest one, the criterion was that he, according to his teachers, was at risk of having difficulties in reading and writing. The second criterion was that the class teacher had a positive attitude to the fact that the child, once or twice a week, would be absent from a regular lesson writing texts on a computer as a research person. The third criterion was that the child himself was willing to take part in the project and that the parents gave their consent. Four children, who fulfilled all the criteria, were found, and they were all appointed to participants in the research project.

The youngest of the four children, Michael, was six years old at the beginning of the project and in a pre-school class. He did not know many letters. He could read and write his own name and the name of his sister, but not much more. The next youngest child, Marc, was seven years old, and in the first grade. He knew many letters, but he could not read out words when the project started. Two of

the children, Chris and John, were nine years old and in the third grade. They could read and write simple words, but they had difficulties with double consonants and with more complicated spelling.

The fifth participant in the project was the teacher. The researcher acted as the teacher in all the writing sessions with the children, and she did participant observation at the same time. The researcher had a degree as a special education teacher and teaching experience.

5.3.3 Equipment

The speech synthesis used was Infovox SA 201, a Swedish multilingual text to speech system based on computer software. The program used was the Ove-programs, made by Irène Dahl and Karoly Galyas (Dahl & Galyas 1987). The Ove-programs contain among other training programs a writing program, "Skrivning", which can be used as a simple word processor with speech synthesis. Dahl and Galyas (Dahl 1997) adapted the system to produce the speech sounds for the letters and not the names of the letters. For the letters A, B, and F, for example, the sounds /a:/, /b/, and /f/ were pronounced, and not the letter names, /a:/, /be:/, and /ef/.

So, when the child wrote a letter in the writing program "Skriva", the speech sound of the letter was immediately pronounced. When the child wrote a word or a part of a word, speech synthesis pronounced it when the space bar was pressed. After punctuation marks the whole sentence was read. With different function keys the user could repeat letters, syllables or other parts of a word, words, a part of a sentence, a full sentence, a part of the text or the whole text, as many times as he wanted. The Ove programs also contained a log on the keystrokes and time, which could be printed out.

If speech synthesis pronounced a word incorrectly, which often occurred with names, but also could occur with other words, the program offered a possibility to change the pronunciation of the word. The speed of speech could be regulated to slower or faster.



Figure 3. A picture from a videotaped lesson

5.3.4 Description of the situation

Figure 4 presents an outline of the situation when children wrote texts with auditory feedback from speech synthesis. The children decided, sometimes with help from the teacher, what text they wanted to write. Auditory feedback came on the text that the children wrote, which means that the character of the text decided the character of feedback. The teacher influenced the text mainly in discussions with the children, but sometimes the teacher corrected words when the writer was not present.

Auditory feedback was not the only kind of feedback on the text. Visual feedback on the screen could of course also be used during writing.

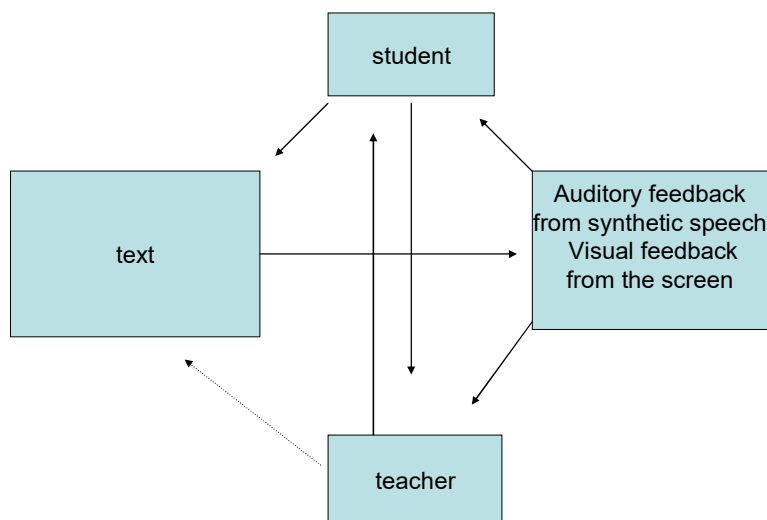


Figure 4. Outline of the situation

5.4 Data collection Instruments

The instrument for collecting data from participant observation were field notes, and the instruments for documentation were keystroke logging, video and the written texts. In the psychologist's testing Raven, NEPSY and the Umesol-test were used.

5.4.1 Field notes

Field notes were taken during the lessons. The teacher/researcher wrote field notes when the pupil was busy writing. The researcher tried to write down what the child did and said when he wrote his texts on the computer: what the child said when he decided what to write, what attempts and corrections he made while writing, how he reacted to auditory feed-back from speech synthesis and what he said to the researcher. The researcher also tried to write down what she said to the child and how she and the child cooperated with the writing.

It was naturally impossible to find time to write down everything during the lesson. The notes were completed immediately afterwards or later the same day as Merriam (1988, pp 96-97) advises. The notes were written by hand during the lessons and were typed and completed later with the log as a support. There are 26 pages of field notes in case one, 20 pages in case two, 21 pages in case three, and 30 pages in case four.

The following example of field notes is from case one, in which the youngest child, Michael, is the leading character, and from the twentieth and last lesson. Michael had declared that he wanted to write about a visit to his grandmother, and he said: "We were at my grandmother's and at a hotel" (Vi var hos mommos och i en hotel). When the sequence began, he had written the Swedish word "vi", (we), and is working with the word "var", (were). M (Michael) is the pupil, and B (Britta) is the teacher. The descriptions are translated to English. Michael used upper-case letters. The text which Michael wrote is on the left side of the field notes, with capital letters.

Field notes Lesson 20, page 1, lines 4-11 (L20.1.4-11)

4. We are sounding out the word "var" (were) together.
M writes:
5. V
When he has written V, he wants to go on to the word "i" (in).
He writes:
6. VR.
M listens when speech synthesis, Ove, pronounces V-R
(because there is no vowel, the names of the letters are pronounced).
M orders pronunciation with F1
Ove pronounces the names of the letters V-R.
7. M erases R, writes H, erases H, writes IR.
8. VIR M listens with F1 to "vir".
V M erases R and I.
M writes A, I
9. VAI He wants immediately to go to the word "i" (in) from "va" ("va" = "var", were)
10. M listens to "vai" with F1, erases I
VA
M writes R
11. VAR (were)

Michael wrote the letter <V> immediately after sounding out the word "var" (were), and he, apparently, knew the letter. It looks like he also knew the letter <R>. Already in the first lessons he knew the letter <A>, but when he should write "var", he left out the vowel, and the result was "VR". He wanted to go on with the next word "i" (in), before the word "var" (were) was completed, and he wrote the letter <I> in the middle of the word "var", with "VIR" as the result. Michael used speech synthesis, ordered pronunciation with F1, and made changes after he had listened to speech synthesis. Eventually he managed to write the word "var".

5.4.2 Log

The computer program provides a log of the use of the keyboard. The log

registered every key stroke and every pause length in seconds between key strokes. The log was used as a control when the field notes were completed. If the field notes were unclear, the log offered a possibility to check.

Here is an example of log from the twentieth lesson, the same lesson from which the example above of field notes is taken:

Produced text:

VI VAR I HELSINGFORS HOS MIN MORMOR.

(We were in Helsinki at my grandmother's)

Log of keystrokes:

VB [226] BSB [30] I [4] VR [27] F1 BSR [15] H [2] BSH [52] IR [16] F1 BSR BSI [27] AI [9] F1 BSI [14] R [5] I [11] [4] F1 F5 F6 [58] HELSINGFORS [157] HOI [115] BSI [5] S [3] MIN [63] MOO [68] F7 F6 BS [61] U [3] BSU 869 Ö [3] BSÖ F1 BSO F1 [107] RR [6] F1 BSR F1 [22] MOR [13] F1 [5] . [2] F1 F5

Michael copied the word Helsingfors, which the teacher had written for him on a piece of paper. BS in the log means Back Step, and it shows what letter Michael has erased. "F" in the log shows that an F-key, a function key is used, which means that the auditory feed-back has been deliberately activated. F1 produces feed-back for the word, F5 for what is written after the cursor, and F6 for all the text. The numbers in brackets are the time in seconds after a key has been pushed.

The log applies information about the work of the writer. Michael used speech synthesis, ordered pronunciation with F1, and changed words after he had listened to speech synthesis.

5.4.3 Video tapes

The plan was to videotape two lessons for each case: one lesson in the beginning and one lesson at the end of the research period. Due to technical problems only one lesson, the last, was videotaped with the youngest child. For the other children, there are videotapes from lessons both at the beginning and at the end of the project.

The child and the teacher sat beside each other in front of the keyboard. The child had a mobile microphone attached to his clothes. The camera filming the child and the teacher was fixed at a stand. The interaction between the child and the teacher could be clearly followed with one camera, because they were sitting at the table almost all the time. The child's speech could be clearly heard. Also, the speech of the teacher was easy to hear.

There were also some problems: It was sometimes difficult to see which key on the keyboard the child was pressing. The letters and the text that appeared on the display could not be observed in the videotapes. The log of the program that registers which keys are pressed could partly compensate for this.

The videotapes were transcribed using transcription conventions according to Ochs, Schegloff and Thompson (1996) with some adaption (Appendix 1). The transcriptions are done with relation to the research questions, because there is a huge amount of information on a video tape, and it is impossible to write down everything (Ochs, 1979).

An example of the transcription of a sequence in a videotape follows here. Michael is going to write about his family's trip to his grandmother in Helsinki. He has already written the word "vi" (we) and is now working on the word "var" (were). This is the same sequence as in the example from field notes and log. The transcript corresponds to lines 8-11 in field notes.

The text that Michael has written is with upper-case letters on the left side. Transcription symbols which are often used in the following excerpt are: double brackets, (()), for a description of what the participants do, and square brackets, [, show that two utterances or acts start simultaneously. The utterances of the participants are in Swedish, the original language, and afterwards there is a translation in brackets. The translation is as close to the original utterance as possible.

Michael is writing the word "var" (were) in the sentence "Vi var i Helsingfors" (We were in Helsinki). He has written the word "vi" (we), and he is working on "var" (were). At first, he wrote <VR>, then erased <R> after listening to auditory feed-back, sounded out /i/ for the word "in", and then wrote <IR> after his <V>, so the result was "VIR".

CD2ML20epi28

VIR B: hmm (.)
 B: minns du vilken du sku lyssna med?
 (Do you remember with which one you should listen?)
 ((M presses F1, Ove pronounces VIR))
 ((M and B look at each other))
 B ((whispering)): va sa den? (what did it say?)
 M: Vir
 B: Ja-a (Yes) ((laughing))
 M: Vi va (we were)
 B: De ska vara var (it should be 'var' (were))
 M ((rotates on the chair)) v-a
 B: Du måst ta och ändra på det nu så det blir var.
 (you must change it now so it will be "var")
 M: A ((M moves his hand to the left over the keyboard, in the direction
 of the A-key. Then he changes the direction of the hand and moves
 the hand to the right and upwards on the keyboard))
 ((M erases R))
VI M: Nu ska vi si (now we shall look)
 B: Ta bort en till (erase another one)
 ((M erases I))

- V B: Sådär (like that)
M: Å sen A: (and then A)
B: Ja: (yes)
- VA ((M pushes the A-key, Ove pronounces A))
M: I:
((M moves his finger over the left side of the keyboard))
[[((B leans forward to M))
[B: Va va de du sku skriva? (what were you going to write?)
M: Vi va i (we were in)
((M pushes the I-key, Ove pronounces I))
- VAI B: Nä jo men du ska ha (no yes but you should have)
((B stretches out her hand over the keyboard))
((M stretches out his hand almost across B:s hand, pushes F1))
((Ove pronounces "VAI"))
((B draws her hand back))
B: Du ska ha var först. Var. (you shall have were first. Were)
B: Om du tar bort- (if you erase -)
((B again stretches out her hand over the keyboard))
B: Det kommer nog I sen, de gör de men
(<I> will come later, it will do that but)
- VA [[((B erases I))
[B: du ska ha var färdigt först (you shall finish "var" (were) first
M: Va:rr
- VAR ((M pushes the R-key, Ove pronounces r))
B: Fint (fine)

Michael had some problems with the word "i", (in), which he started to write too early, so it was mixed up with the word "var" (were). He could use auditory feed-back and made changes according to it. These circumstances were also put down in the field notes.

The word "var" is pronounced /va/ in Swedish informal speech, and Michael tried at first to write only "va", and directly after that, the preposition "i"(in). Michael used feed-back on his own initiative, but the teacher did the erasing of the letter I for him. In the field notes there was no notation that the teacher did the erasing.

5.4.4 Printed texts

The texts the children had produced were printed out after every lesson. The texts can be found in Appendices 3, 5, 7 and 9.

Michael produced the following text in Lesson 20: JAG OCH ANNA OCH PAPPA OCH NAPPE VAR I HELSINGFORS. VI VAR I HELSINGFORS HOS MIN MORMOR. (I and Anna and Dad and Nappe were in Helsinki. We were in Helsinki at my grandmother's).

5.4.5 Psychological testing of reading and writing difficulties

A psychologist made an assessment report for each child based on testing before and after the research period. The tests which the psychologist used for assessment were Raven's Coloured Progressive Matrices (Raven, 1981), parts of NEPSY (Korkman, 1990) and parts of UMESOL (Taube, Tornéus & Lundberg, 1984). The assessment reports can be found in Appendices 2, 4, 6 and 8.

Raven's Progressive Matrices is a nonverbal test which is used in measuring abstract reasoning and regarded as a non-verbal estimate of general intelligence. All questions consist of visual geometric design with a missing piece. Coloured Progressive Matrices is a form of the Matrices which is designed for children (Raven, 1981).

NEPSY is a test for developmental neuropsychological assessment, which is developed in Finland by Marit Korkman. A Swedish version appeared in 1990 and an English version in 1998. The original version of the NEPSY consisted of five theoretically derived domains: Attention and Executive Functioning, Language, Memory and Learning, Sensorimotor, and Visuospatial Processing. A revised version, NEPSY-II appeared in 2007 (Korkman, 1990; Kemp & Korkman, 2010).

UMESOL is a pedagogical tool for surveying reading and writing difficulties and for making individual development programmes in grades 1-3. UMESOL consists of three parts: phonological awareness, reading and writing, and self-image. Phonological awareness tests consist of phoneme segmentation, phoneme synthesis, position analysis and segment subtraction. The Reading and writing tests consist of listening comprehension, letter knowledge, text copying, reading and writing of words and texts, proof-reading and reading comprehension (Taube, Tornéus & Lundberg, 1984).

5.5 Data Analysis Procedures

This chapter describes the steps in which the analysis of data was done. The first step was the construction of a case study database.

5.5.1 The construction of a case study database

The field notes, which were written by hand during the lessons, were completed on the same day. The log was printed out. The field notes were typed afterwards, and the log was used to check unclear descriptions in the field notes.

The videotapes were transcribed after the field notes were completed. The field notes from the videotaped lessons were checked and compared with the videotapes. The field notes did not deviate from the videotapes, but of course the videotapes contained much more information. If it was difficult to see on the videotape what keys the child used on the keyboard, i.e. what letters he wrote, the information could be found in the log.

The database consisted of about twenty pages of field notes for each case. An excerpt from the field notes is marked with the name of the case person, the number of the lesson, the number of the page if there were more than one page for the lesson, and the number of the line. The example of field notes in chapter 5.4.1 has the number M,L20.1.4-11.

The videotapes were 52 minutes for Michael, 70 minutes for Marc, 71 minutes for Chris and 69 minutes for John. The transcriptions are divided into sequences, episodes. An episode can be writing of a word or a piece of conversation. An excerpt from a video transcription is marked with the number of the CD, the name of the person, the number of the lesson and of the episode, the example of videotapes in 5.4.3 is marked CD2M20epi28.

5.5.2 Themes in the material

The next step was to review the material in the database, the field notes, the videotapes and the transcriptions. The research questions were the starting point of the review.

The field notes were studied first. Material relating to the research questions was collected from the lessons under the following headings: Development of literacy skills, use of feed-back, scaffolding performed by the teacher. The material was compared to the inquiry in the research questions.

There was a rich material which corresponded to the research question about the development of literacy skills, basic skills and developing skills, and to the examples which were mentioned, among others letter knowledge, spelling of words and punctuation. In all four cases there were examples of play with words and creation of new words. A prerequisite of writing and of getting any material at all to analyse is that the children were willing to write. The material also gave the possibility to describe how the children's willingness and urge to write developed as an important literacy skill.

There were field notes describing how children used the auditory feed-back and how the teacher scaffolded the activity. The field notes gave some information about the teacher's thinking in the situation. However, the field notes about the teacher/researcher's own behaviour did not feel complete and reliable enough, so the videotapes were of good use especially for the research question about scaffolding.

The videotapes were used as a check of the field notes of the lessons where video was used. Sometimes, in the field notes there was only a hint of something that happened, and on the videotape the course of event could be studied more closely. The videotapes contained much more information than the field notes. Especially the study of teacher scaffolding was to a great extent made on basis of the videotapes.

5.5.3 Descriptions of cases

The next step was to write a description of each of the four cases. The descriptions have their starting points in the research questions and in the

themes in the material. I tried to find the characteristics of the cases, and I wrote a “thick” description with many examples for each case. The descriptions were ordered according to the age of the children, so that the youngest child is the principal character in case 1.

5.5.4 Comparison of cases

The last step was to compare how the answers to the research questions appeared in the four cases, and to analyse how they related to theoretical considerations.

5.6 The Quality of the Research Design

Concepts that have been offered to test the quality of a research design include trustworthiness, credibility, confirmability, and data dependability (Yin 1994, pp 32-33, 2009, pp 40-41). Four tests are commonly used to establish the quality of case studies as a form of empirical social research. The tests are construct validity, internal validity, external validity and reliability.

Construct validity means that correct operational measures are established for the concepts being studied. According to Yin, construct validity is especially problematic in case study research. To meet the test of construct validity, the specific types of changes that are to be studied must be selected, and the selected measures of these changes must reflect the specific types of change that have been selected.

There are three tactics available for case studies to increase construct validity (Yin 1994, p 34). The first is the use of multiple sources of evidence, in a manner encouraging convergent lines of inquiry. The other tactics are to establish a chain of evidence and to have the draft case study report reviewed by key informants.

Multiple sources of evidence are used in my study: participant observation, testing and documentation by video recording and keystroke logging. Data from different sources on the same phenomenon are compared with a triangulating logic (Yin 1994, pp 91-92). The tactic to use multiple sources of evidence is chosen to increase construct validity in this study.

Internal and external validity

Internal validity is an item for explanatory or casual studies only, establishing a causal relationship, and is not relevant for my study. External validity refers to the problem whether a study’s findings are generalizable beyond the immediate case study (Yin 1994, 2009). In a case study, the findings are not generalized to a population, but to a theoretical framework. A multiple-case study is guided by replication logic and not by sampling logic (Yin 1994, pp 45-46). To use multiple cases, like in this study, is a tactic which improves the external validity (5.2.1).

Reliability

The objective of reliability in a case study is that, if a later investigator followed exactly the same procedures as described by an earlier investigator and

conducted the same case study over again, the later investigator should arrive at the same findings and conclusions (Yin 1994, pp 36-37).

During data collection, materials from different sources were checked against each other in my study. When the field notes were completed after the lessons, the log was used as a control. When the videotapes were transcribed, the log could be used if the situation was unclear.

The field notes were completed and printed out before the videotapes were transcribed. Then, the field notes from the videotaped lessons could be compared with the videotapes. The content of field notes could be controlled with the videotapes in this way.

5.7 Ethical Considerations

The Finnish Advisory Board on Research Integrity (2012) declares that research shall follow the principles “integrity, meticulousness, and accuracy in conducting research, and in recording, presenting, and evaluating the research results”. There are also ethical principles for research especially in the humanities and social and behavioural sciences (National Advisory Board on Research Ethics, 2009). These principles are divided into three areas: Respecting the autonomy of research subjects, Avoiding harm, and Privacy and data protection.

Participation in research should be voluntary and based on informed consent, and research subjects can give consent orally or in writing. In my study, the class teacher informed the parents of the children, and the parents gave their consent to the class teacher. Before the project started, I asked the children if they wanted to come and write on the “speaking computer”, and they said that they would like to do that. The headmaster of the school was informed and gave consent, and the class teacher and the special education teacher chose the children who should be research persons.

Avoiding harm is another important ethical principle. In my study, there was a risk to cause the children some harm, because they were absent from their ordinary teaching at least twenty times for half an hour, and sometimes even longer. The class teachers and I tried to arrange the point of time for the research sessions to cause as little harm as possible. If the classmates received some important information when the research children were absent, the teachers helped the children to pick up such information. The children got extra training in reading and writing during the project, which might have been a good compensation for the teaching time they lost in their own class.

The protection of privacy is an established and important principle in research ethics. The real names of the children are naturally not used in my study. The

children wanted sometimes to write names of family members. If there are several such names in a text, the names are changed or not referred to.

6 Writing Some Words and Learning Many Letters. Case 1

The principal character in case one is Michael, who was six years old when the project started. He was in a pre-school class, which worked together with the first and second grade in the school. He wrote words and texts with auditory feedback from speech synthesis in cooperation with a teacher, once or twice a week from January to May. In some lessons, he also worked with word cards and with an Ove hangman game with letters. Michael knew only some upper-case letters and very few lower-case letters when the project started. He knew how to write his own name, but not more than that. He did not know how to read words, and he had a low score in phonological awareness (Appendix 2).

Twenty lessons were held with Michael, and the mean length of a lesson was 28 minutes. Lesson twenty, the last lesson, was videotaped, and it was longer than usual, 52 minutes.

The teacher chose capital letters for Michael, so Michael wrote his words and texts with capital letters during all the lessons. He sometimes checked that the keyboard was adjusted for capital letters (CD2MiL20Epi27). When letters and words, which Michael wrote, appear in this chapter in quotations from the field notes and from the videotape, they are written with capital letters.

References to field notes are made with lesson, page and line number, for example (L.1.1.8-10), and references to videotapes with CD number, name, lesson number and episode number, as in the example above.

The development of basic literacy skills, which corresponds to the first research question, is dealt with in chapters 6.1, 6.2, 6.3, and 6.4. The following aspects of literacy skills development are presented: willingness to write, letter knowledge, word writing and text writing. The use of auditory feedback, which corresponds to the second research question, is dealt with in chapter 6.5, and scaffolding writing, the third research question, is dealt with in chapter 6.6. The use of auditory feedback and especially scaffolding is closely tied to the circumstance where it happens (van de Pol et al., 2017, p 286). Because of that, scaffolding and the use of auditory feedback are presented also in the context, that means in the context of literacy skills development, in chapters 6.1.3, 6.2.4 and 6.3.4. The chapters are finished with a passage called “summarising reflections”.

6.1 Development of Literacy Skills: to Find the Urge to Write

In the first lesson, Michael was interested in the computer and in listening to the synthetic speech when the teacher showed how speech synthesis pronounced what she wrote on the keyboard, (L1.1.6). However, when the teacher suggested

that Michael should write something, he answered: "I don't know how to write", (L1.1.8-10), and he was not so eager to try. Nevertheless, he could write his own name, and he started with writing that. Then, with the help of the teacher and the speech synthesis, he also wrote some other names.

6.1.1 Finding something to write about

Michael wanted to continue to write names during the following lessons. He wrote names of family members, pets and friends. However, when he arrived for the fourth lesson, he asked: "Must I write, too?" (L4.1.4-5). That lesson could start without writing, for the teacher had prepared word cards with the names that Michael had written in the previous lessons. After some work with word cards, Michael was willing to write the name of a stage play (L4.1.17-18), DUMMERJÖNS, which he had recently attended with his class.

During the following lessons, Michael told the teacher a whole sentence that he wanted to write, about animals or about something he intended to do. The teacher wrote some words on a paper for him to copy, and he wrote easier words more independently using the auditory feedback. For example: Michael said that he wanted to write: "Maybe I shall buy a film. A Robocop". (Jag ska kanske köpa en film. En Robocop) (L5.1.7-26). The teacher wrote the first sentence on a paper and Michael copied it on the keyboard. After that he wrote the word "ROBOCOP", quite independently.

When lesson nine was about to start, Michael did not want to go with the teacher to the computer (L9.1.1). The teacher tried to persuade him, and she said that they could print out what he had written last time. Then, Michael decided to come. Unfortunately, the printer did not work, and Michael could not have his writings printed as the teacher had promised (L9.1.2). However, Michael looked at the screen and saw the sentence he had written the lesson before, and he started to complete it. The result was the longest sentence so far: "Lasse, the turtle, is in the same place almost all the time". (SKÖLDPADDAN LASSE ÄR PÅ SAMMA PLATS NÄSTAN HELA TIDEN).

The teacher changed the activity for the next lessons to another part of the Ove-program, a Hangman Game with speech synthesis. The task in the Hangman Game was to guess letters to find out what words the partner had written, and speech synthesis pronounced the letters. The teacher wrote the words and Michael guessed letters. When Michael came for lesson eleven, he declared: "This is the last time" (L11.2). However, he played the Hangman Game with the teacher, and after a while, he suggested that they would change roles (L11.17). Michael chose the words, mostly names, and wrote them for the game, and the teacher guessed letters.

Michael came to the following lesson despite his earlier declaration of "the last time". He said, that he wanted to play Hangman and that he wanted to write the words first, and that the teacher should guess (L12.1). The teacher fulfilled his wishes. In the next lesson (L13) no keyboard work at all was done, only work with word cards on the words which Michael had written during earlier lessons, and some picture drawing. After that (L14.12-13) the teacher asked Michael

what he would like to write, and the answer was: “Nothing very interesting” (Ingenting så intressant). Nevertheless, he consented to writing “Glad påsk” (Happy Easter) (L14.15-31). He used auditory feedback from speech synthesis to find the letters (chapter 6.5). The field notes report that he twice lost his interest in writing, when he had difficulties in finding the letters (L14.16;28). When he finally had finished his GLAD PÅSK (Happy Easter), he printed out his text and drew a picture of an Easter bunny on it.

The two following lessons consisted of Hangman with speech synthesis, until the teacher in lesson seventeen dared to ask Michael what he wanted to write. The answer was “I don’t know” (Jag vet int) (L17.3). The teacher asked if he would like to write “I don’t know” (jag vet inte), and Michael accepted it with a smile, apparently amused, and started to write. When the sentence was almost finished, some technical problem occurred, and the Ove-program did not respond. The teacher let Michael play a Math Blaster game with simple addition and subtraction tasks (L17.23-25) for the rest of the lesson.

Michael came to the next lesson without hesitation (L.18.1), but he was not so interested to write. He said that he wanted to play the Math Blaster, and that it was so fun. Anyhow, he said a sentence about a dog: “Raffel was outside for the first time” (Raffel var den första gången ute) (L18.2), and then he started to write. When he had written the first two words, the Ove program hooked up again, and he could play some Math Blaster. During the following lesson Michael wanted to write only his name, and then he wrote the numbers 1-9 (L19.5-7) and the letters A-G in the alphabet independently (L19.11-12). He was able to write the letters H-Ö with assistance from the teacher (L19.13-14).

Lesson twenty, the last lesson, was videotaped. Michael quickly started the computer and found the actual program, but it took some time before he found something to write (L20.1.3). He started with his own name and the name of his sister, and then he said: “Can we say: I and Anna were in Helsinki with my dad?” (ska vi säga jag och Anna var i Helsingfors med min pappa (L20.1.5, VL20.4.07.9). Michael talked about a family trip to Helsinki. He made a story about the trip, he wrote the names and the short words rather independently, and he used speech synthesis for help. The teacher wrote only the long word Helsinki (Helsingfors) on a paper for him to copy from. The result was a text of two sentences, the longest text Michael produced during the project, “I and Anna and Dad and Nappe were in Helsinki. We were in Helsinki at my Grandmother’s” (JAG OCH ANNA OCH PAPPAN OCH NAPPE VAR I HELSINGFORS. VI VAR I HELSINGFORS HOS MIN MORMOR). All Michael’s texts can be found in Appendix 3.

6.1.2 Playing with words and sounds

Michael played with letters and their sounds, and he invented new words out of the words he was writing. He wrote Klas, the name of a family member (L2.1.35-38). When he had written KLA, and listened when speech synthesis pronounced it, he exclaimed: “gla, som glad, när julen kommer ska varenda unge vara glad” (glad=happy, in a popular Christmas song for children). The teacher did not react

to the confusion of k and g, but went on to sound out and complete “Klas” (L2.1.39-41) together with Michael.

In lesson four, Michael wrote “Dummerjöns”, a name from a play. He had written the first two letters, DU, which made the word “du”, Swedish for “you”. Then he said that if he wrote “Du Michael” (You Michael), the computer would pronounce it. He wrote DU MICHAEL and listened to it (L4.1.25-28). After that he erased it and went on to write “Dummerjöns”. When he had written DUMM, he exclaimed “Dum Michael” (stupid Michael), and wrote: DUMMMICHAEL (L4.1.31-33). He listened to his word, laughed, erased it and went on writing “Dummerjöns”. The teacher did not comment Michael’s inventions of words (L4.1.30, 34-35). She just continued to sound out “Dummerjöns”, trying to help him to write the word.

Michael intended to write “mormor” (grandmother) (L20.2.22-24). He wrote MO, and then he wrote another <O>, so he had written MOO. He listened to it, laughed, and exclaimed: “A cow says moo” (en kossa säger ju moo). He created a new word from the letters he wrote to make the beginning of another word.

Michael tried out the buttons on the keyboard with letters and numbers, and he used them in a creative way. He found out that he could use the number 1 to make speech synthesis pronounce the word “ett” (one). He had decided to write about a turtle called Lasse, which stayed in one place almost all the time (Sköldpaddan Lasse är på en plats nästan hela tiden). When he had written the first words of the sentence and was ready to write the word “en” (one), he said “ett” (one) and pressed the number 1. The teacher told him that letters must be used. Michael erased 1 and wrote EN. After that he pressed 1 once more, listened with F1, and then erased the number (L9.1.15-17).

6.1.3 Summarising reflections

Writing was a demanding task for Michael. Although he did not have to write letters with a pencil, it was difficult for him also to find letters on the keyboard, when he, in the first lessons, only knew a few letters. He told the teacher in the first lesson that he did not know how to write (L1.1.8-10). He seemed to have considerable doubts about his own ability as a writer, and he seemed to have a writing self-efficacy at a low level, which made him unwilling to try (Boscolo, 2009; Bandura, 1997).

Michael seemed to be genuinely interested in the computer. He ordered feedback and listened to it, he wanted to see his writings printed out (L9.1), and he told the teacher that he wanted to play computer games (L18.1). When he played the Hangman Game with the teacher, he said that he wanted to write the words for the teacher to guess (L12.1), and he did so, even though he had difficulties to write understandable words. Michael’s interest in the computer made him willing to try to write words. Michael apparently also found some interest in his topics for writing, when he wrote names of family members and pets and later small sentences about pets, friends and family trips.

Some examples of scaffolding functions (Wood, Bruner & Ross, 1976) are found in the interaction between the teacher and Michael. When Michael showed

that he did not want to write and even did not want to come and work on the computer (L4.1.4-5), the teacher changed the activity, which can be characterised as scaffolding in the category frustration control (Wood et al., 1976, p). When Michael said a sentence that he wanted to write, the teacher wrote some of the words on a piece of paper, so he could copy them on the computer, in the same way as in the example above about the film (L5.1.7-26). The scaffolding functions here are simplifying the task for the learner (Wood et al., 1976) and perhaps also frustration control.

Michael showed an ability to play with words and to invent new words from the sounds which were pronounced by speech synthesis. He showed a great deal of phonological awareness when he analysed the sounds and invented new words. He made the words after he had listened to speech synthesis, and he was apparently inspired by speech synthesis to invent new words and to play with words and sounds. He also tried out the possibilities of the keyboard.

The teacher made no attempt to inspire or scaffold Michael in his creative word play. She seemed more interested in his spelling of the words in the sentence which he was writing. However, the teacher did not prevent him from writing and saying his invented words. Only on one occasion the teacher stopped his playful discovery of the keyboard. When he tried to use the number 1 instead of the word “one”, the teacher told him to use letters (L.9.1.15-17).

6.2 Development of Literacy Skills: Knowledge of Letters

Michael knew only a few letters when the project started. In the pre-testing (appendix 2) he could tell the names of three letters, <M>, <A>, <S>, and two of them were in his own name. He could write his own name and, at least partially, his sister’s name, and he possibly also knew the first letter in some other names. When he started to write other words with auditory feed-back, his first task was to “sound out” the speech sounds in the word, and to try to find the phonemes, which the word consisted of.

He searched for the phonemes and the corresponding letters in co-operation with the teacher and tried them out with speech synthesis. In the first lesson (L1.1.37-45), he wanted to write Nappe, a dog’s name. “Nappe begins with A”, he said. Then the teacher started to pronounce the dog’s name and exaggerate /n/: “Nnnappe”. Michael joined the teacher in sounding out, and soon he could pronounce /n/. When Michael had said the sound, the phoneme /n/, the teacher helped him to find the letter and pointed to it on the keyboard, Michael pressed the key, and he could listen to speech synthesis pronouncing the sound. He could not independently find the first sound in the word, but when he sounded out together with the teacher, he could also say the sound. He learned gradually to sound out many phonemes by himself, but he often needed the teacher’s help to find the letter.

Michael usually used both letter names and letter sounds, and the use of letter names could sometimes cause problems in word writing (6.2.2).

I present three examples where Michael worked with a letter and its sound: the letters <R>, <E> and <O>. In the earlier lessons he could not find the letters without help from the teacher, but in the later lessons he could find the sounds and the letters <R> and <E> independently. He had learned the letters and their sound. Of course, it is not possible to tell exactly when learning happened, he worked with letters in his pre-school class also, but the following examples show how learning appears in field notes, log and videotapes. On the contrary, Michael's work with the letter <O> is more an example of non-learning.

6.2.1 Michael learns the letter <R>

When Michael wanted to write names of siblings and friends in the first lesson, one of the names was Artur, where the letter R occurs twice. Michael could sound out /r/, at least together with the teacher, but he did not find the letter on the keyboard, and the teacher had to point it out. Then, in the next lesson, Michael wanted to write "Artur" again, and now he found <R> on the keyboard. Some lessons later, Michael was again writing words with <R>, "Dummerjöns" and "Robocop", and now he had no problems with the letter.

Field notes from lessons 1, 2, 4, 5.

Lesson 1.1.28-30.

Michael wants to write the name of a friend, Artur. He already knows the letter A. We are sounding out the rest of the letters together. He can sound out the letters R and U. We are sounding out together, and if Michael does not know what letter it is, I point it out on the keyboard.

Lesson 2.1.8-10

Michael starts to write the name Artur. He writes A immediately. We sound out R together, and Michael finds it on the keyboard. After that he writes T independently. He sounds out U with a little help from me, but he points to O.

Lesson 4

Michael is writing "Dummerjöns", the name of a play he has recently seen with his class, and he has written the beginning of the word, DU.

4.1.29-31 DU I pronounce "Dummer" extra clearly and help Michael to sound out. Michael writes MM.

4.34-36 DUMM We are sounding out "Dummer". I help him with E and show it on the keyboard. Michael can hear that R is the last letter, and he also knows what it looks like.

DUMMER Michael listens to the result a couple of times.

Lesson 5.

Michael wants to write that he may be going to buy a film, Robocop.

5.17-19. I try to let him write Robocop independently. He sounds out /o/ and /r/, and writes: RO.

According to the field notes, the teacher withdrew in lesson five and let Michael find out the letter <R> on his own.

6.2.2 Michael learns the letter <E>

When Michael was writing the name “Dummerjöns” in lesson four, (L4.34-36), which is described in chapter 6.2.1, he did not know the letter <E>, and the teacher showed him <E> at the keyboard. A little later, in lesson six, Michael wanted to write about his friend “Emilia” (L6.1.5-8). - Emilia begins with ‘E’ (Emilia börjar på E), he said. Then he was searching for <E> for a long time, and he did not seem to know what the letter looks like.

In lesson eight, Michael had decided to write: “The turtle is called Lasse” (Sköldpaddan heter Lasse) (L8.1.14-32). The letter <e> occurs three times in the sentence, in the word “heter” (is called), and in the name “Lasse”. Michael could sound out /h/ and /r/, and he found them on the keyboard, but the teacher had to help him to sound out /e/ and to find the letter <E>, both the first and the second time it occurred in “heter”. The same thing happened when Michael wrote “Lasse”. He had much practise with <E> in the sentence, but he did not seem to know it yet.

Field notes from lesson 8.

L8.1.18-23: Michael writes “heter”.

He sounds H out and finds it on the keyboard. Then he sounds R out. I help him to sound E out, and I must also show it on the keyboard.

L8.1.24-32 Michael writes “Lasse”.

He finds L after some attempts, he sounds A out and finds it. He sounds S out but has some difficulties to find it. He listens with F2 to “LASS”.

I must sound “E” out. Apparently, Michael does not know what E looks like, he writes D and T, but removes them when he has heard them pronounced by the speech synthesis. I show him E on the keyboard.

In lesson seventeen (L17.1.6-22) Michael was going to write “I don’t know” (Jag vet inte). He had written “jag” (I) and had started to write “vet” (know), where the letter <e> occurs (L17.1.10). He had sounded /v/ out and had found <V> on the keyboard. Then he sounded also /e/ out, and immediately found <E>. Now he could apparently both recognise the sound and the letter <E>.

In the twentieth and last lesson, which was videotaped, Michael was writing “Nappe”, the name of a dog (CD2MiL20Epi22). He wrote NAPP rather easily. With a little help from the teacher he recognised the sound for <e>, though he had some problems with the name of the letter <p>, in Swedish: “pe”, which contains both the sound for <p> and <e>. When he had recognised the sound for <e>, he had no problems finding the letter. The transcription of the passage follows here:

CD2MiL20Epi22, Michael writes Napp

NAPP B: Nu står det Napp B: now it says Napp
((B böjer sig fram mot M, tar ögonkontakt ((B bends forward to M, looks
into his eyes))
M: Pe ((tittar på B)) M: Pe ((looks at B))
B: de ska va en bokstav till så de ska bli Nappe B: there should be another
letter
to make it Nappe
M: Pe ((tittar på B)) M: Pe ((looks at
B))
B:Nappe: B: Nappe:
M: e M: e
B: hmm ((nickar)) B: hmm ((nods))
M: den – den ((M visar på E, trycker på E)) M: that – that ((M points to E,
presses the E- key))
NAPPE B: Ja. Fint. Fint hör du. B: yes. fine, fine you see

6.2.3 Michael does not learn the letter <O>

In lesson 20 Michael was going to write two words with the letter <O>. In Swedish, <o> is usually pronounced /u/ when it is a long vowel, like in “hos” (at), and usually /o/ when it is a short vowel, like in “hotell” (hotel). A short vowel <o> can also be pronounced /u/, like in “mommo” (granny). The vowel <u> is usually pronounced /ʉ/.

Michael had said that he wanted to write “Vi var hos mommos och i en hotel” (We were at Granny’s and at a hotel). He was writing the word “hos” (at) (CD2MiL20epi33), and the teacher had pronounced “hos” a couple of times. Michael suggested /u/ as the first sound, and the teacher explained that another sound will come before. After some other suggestions Michael found the first sound /h/ and wrote <H>, and the teacher made a notation in the field notes. Then Michael suggested /a/ and /s/ as the next sound, and not the vowel sound /u/, and he turned around on his chair and looked out of the window. The teacher pronounced “hos” several times. At last the teacher pointed to <O> on the keyboard, but she did not pronounce /u/, just said “Hos. There it is”. Michael then pressed the O-key, and the speech synthesis, at least, spoke /u/ out.

Episode 33 Michael writes “hos”

B: hos B: hos
((M rör på armarna, lutar sig mot ((M moves his arms, leans against the
fönstret)) window))
M: o: M: o: (/u:/)
B: det kommer en annan före. Hör du B: There is another before.
det? Can you hear it?
M: sss M: sss
B: den kommer också. Hos, hos. B: it will also come. Ho:s. Ho:s.
M: hh-o, hh M: hh-o, hh

((B nickar))
M: ho:, hh, h
[[((M trycker på H))
H
[[((B antecknar
M ((viskar)): h h hhos
B: mm
((M rör på sig, snurrar på stolen
sträcker på sig))
M: a
B: hos ((ögonkontakt med M))
((M snurrar mot tangentbordet,
snurrar tillbaka mot B, ögonkontakt
med B))
M: ss
((M snurrar runt på stolen, rör på
armar och ben, vänder stolen mot
fönstret))
B: De ska va en före.

B: En som du sagt ren
((M snurrar lite på stolen))
B: ho:s
M: a
((M tittar ut genom fönstret))
[B: Hos. Där har du se
[[((B pekar på O))
((M svänger sig mot datorn))
HO
((M trycker på O, som talsyntesen
uttalar))

((B nods))
M: ho: hh h
[[((M presses the H-key))]]
H
[[((B makes a notation))
M: ((whispering)) h h hhos
B: mm
((M turns around on the chair,
straightens himself up))
M: a
B: hos ((looks M in the eyes)
((M turns towards the keyboard, turns
back to B, looks B in the eyes))

M: ss
((M turns around on the chair, moves
legs and arms, turns the chair to the
window))
B: There should be one (letter) before
that.
B: One that you have already said.
((M turns a little on the chair))
B: ho:s
M: a
((M looks out through the window))
[B: Hos. There it is
[[((B points to O))
((M turns towards the computer))
HO
((M presses the O-key. speech synthesis
pronounces o))

The teacher did not pronounce the sound /u/, she just pointed to the letter on the keyboard and said: "there it is". The teacher made only a short notation in the field notes, but after that Michael turned around on the chair and looked out through the window.

Now Michael started to write the word "mommo", and he needed the letter <O> again. He had written the first letter, <M>, and was sounding out the rest of the word: "mmi, mo". Then the teacher pointed to the O-key, saying nothing, and Michael wrote <O>. When he had written "MO", the first part of the word, he still went on suggesting /u/, and he said: "mommo, o". The teacher was writing field notes and focused on that. Michael wrote another <O>, so the result was MOO.

After that he tried <U>, he heard speech synthesis pronounce it, and erased <U>. Then he tried <Ö>, listened, and erased. After that he suggested /u/ again.

Episode 35 Michael is writing "mommo"

<p>M <i>((M trycker på bokstaven M, Ove uttalar M))</i> M: mmi, mo <i>((B pekar på bokstaven O))</i> M: mm</p>	<p>M <i>((M presses the M-key, Ove pronounces M))</i> M: mmi, mo <i>((B points to the letter O))</i> M: mm</p>
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Again, the teacher did not pronounce the sound /u/, just pointed to the letter O. Michael said "m" at the same time as the teacher pointed to <O>.

<p>MO <i>((M tar bokstaven O, Ove uttalar O))</i> () <i>((B o M tittar på varann))</i> M: mo <i>((B nickar svagt))</i> M: o B: int de M: va <i>((M rör handen över tangentbordet))</i> B: mommo M: mmo o M: mommo o <i>((M vänder sig bort från tangentbordet, svänger tillbaka, tittar ut genom fönstret))</i> M: o B: Ja du kan prova. Ja ska skriva lite <i>((B börjar skriva fältanteckningar))</i> MOO <i>((M trycker på O, Ove uttalar O))</i> M: jo hos () min () mommo M: O. O. O måst de vara M: O. <i>((pekar på tangenten U))</i> B: prova <i>((B skriver fältanteckningar))</i> MOOU</p>	<p>MO <i>((M presses the O-key, Ove pronounces O))</i> () <i>((B o M look at each other))</i> M: mo <i>((B nods faintly))</i> M: o B: not that M: what <i>((M moves his hand over the keyboard))</i> B: mommo M: mmo o M: mommo o <i>((M turns away from the keyboard, turns back, looks out through the window))</i> M: o B: Yes you can try. I shall write something <i>((B starts to write field notes))</i> MOO <i>((M presses the O-key, Ove pronounces O))</i> M: yes, at() my() granny's M: O. O. O it must be M: O <i>((points to the U-key))</i> B: try <i>((B writes fieldnotes))</i> MOOU</p>
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<i>((M trycker på bokstaven U, Ove säger U, M raderar U))</i>	<i>((M presses the U-key, Ove pronounces U (u), M erases U))</i>
<i>M: U. det var U. O.</i>	<i>M: U. it was U. O.</i>
<i>MOOÖ</i>	<i>MOOÖ</i>
<i>((M trycker på bokstaven Ö. Ove säger Ö. M raderar Ö</i>	<i>((M presses the Ö-key. Ove pronounces Ö. M erases Ö))</i>

When Michael already had written MO, and even when he had written MOO, he suggested /u/ again, but he did not seem to be sure of which letter corresponded to /u/, because he also tried <U> and <Ö>. The teacher did not help him. It is possible that he meant the last sound in the word “mommo”. He often started to sound out a word backwards, and it is possible that he tried to do so this time also. The teacher was busy writing field notes, and she did not pay very much attention to Michael’s writing problem.

<i>MOO M: Hur va de som ja sa? O</i>	<i>M: What did I say? O.</i>
<i>M: O: O ((M tittar på B)) O</i>	<i>M: O: O ((M looks at B)) O</i>
<i>((B visar med pennan på F2))</i>	<i>((B points to F2 with her pencil))</i>
<i>B: lyssna med den här</i>	<i>B: listen with this one</i>
<i>((M tar F2, Ove uttalar Mo-o</i>	<i>((M presses F2, Ove pronounces Mo-o))</i>
<i>M: R. Sen kan man sätta mor</i>	<i>M: R. Then you can put “mor” (mother)</i>
<i>((B skriver fältanteckningar))</i>	<i>((B writes field notes))</i>

The teacher told Michael to listen with F2 to “moo” again, and Michael did that. When he had listened to “moo” again from the speech synthesis, Michael made a new suggestion: “R. Then you can put “mor” (mother)”. The teacher did not notice Michael’s suggestion of “mor”. Instead, she suggested that Michael should erase a letter from “MOO”, again without pronouncing /u/. Michael did so, and he repeated twice, that he should write “mor”, and then, eventually, the teacher heard him.

The teacher asked if he wanted to write “mormor” (grandmother), and Michael said yes. When he had written “mor”, the teacher recommended that he should write the same word once more. Michael wrote “mormor”, and the teacher had once more avoided to pronounce /u/. Anyhow, the result of all this was that Michael got his story completed, and he could listen when speech synthesis read his text out. Michael smiled contentedly when he listened to his story (CD2MiL20epi36).

6.2.4 Summarising reflections

Michael and the teacher were sounding out the words together many times in the examples above. The teacher gave a demonstration, a model for the sounding out, and Michael joined in. The teacher exaggerated the actual sound, /r/ and /e/ in these examples, and the modelling “involved an idealization of the act to be performed” (Wood et al., 1976, p 98).

If Michael did not find the letter on the keyboard after he had sounded it out, the teacher pointed to the letter on the keyboard. With the pointing, the teacher simplified the task by reducing the number of constituent acts required to reach solution (Wood et al., 1976, p 98) and reduced the task to the level where the learner could recognize whether he had achieved a “fit” with task requirements. When speech synthesis pronounced the target sound, and later the word, Michael could consider if he had achieved a “fit” with the word he intended to write.

Sometimes the teacher did not show Michael the corresponding letter immediately when he had pronounced the sound, but she let him try out some letters, like above when he was looking for <e> after having written LASS. Michael used auditory feed-back to decide whether he had found the intended letter or not.

The scaffolding functions found in the teacher’s and Michael’s work with <R> and <E> are modelling and simplifying the task (Wood et al., 1976). Feedback, in this case provided by speech synthesis, is one of the means to assist performance which Tharp and Gallimore (1988) mention.

When Michael was going to write the words with <o>, he had no problem to sound out /u/, but he was not sure of what the letter <O> looked like. The teacher pointed to the letter <O> on the keyboard when Michael needed it, but she did not pronounce the sound at the same time. The teacher used the scaffolding function of simplifying the task (Wood et al., 1976), but she did not simultaneously model the sound. When Michael wrote “mommo” (granny), he started to sound out the end of the word when he had written the beginning, MO. The teacher was busy writing field notes, and she was not very attentive to Michael’s problems.

After Michael had learned <R>, the teacher withdrew and let him find the letter by himself, according to the field notes from lesson five. With the letter <E>, the field notes mention that Michael wrote the letter independently, which indicates that the teacher withdrew. The teacher also withdrew during the work with <O>, but that was because of her writing of field notes, and it happened when Michael did not yet have a steady knowledge of <O>, so it was not a withdrawal which was a characteristic of scaffolding.

6.2.5 Overview of letter knowledge

The development of letter knowledge can be studied in the assessment report, in the field notes and in the videotapes.

Table 2. Letter knowledge according to the field notes, Case 1

	1.	2.	3.	4.	5.
Lessons	<i>M cannot sound out the letter, does not find it on the keyboard</i>	<i>M sounds out the letter with the teacher, does not find it on the keyboard</i>	<i>M can sound out the letter by himself, but does not find it on the keyboard</i>	<i>If the teacher sounds out the letter, M finds it on the keyboard</i>	<i>M can sound out the letter, finds it on the keyboard</i>
1		<i>N, V</i>	<i>R, U</i>		<i>A</i>
2		<i>N, P</i>	<i>U</i>	<i>E</i>	<i>A, (R), (T)</i>
3					
4	<i>E, Ö, J</i>		<i>D, U, N, S</i>		<i>R, M</i>
5			<i>Ä, P</i>	<i>B</i>	<i>R, (T), (U)</i>
6		<i>L</i>			<i>I, A, M, R, (E)</i>
7					<i>V, N, I, S</i>
8	<i>E, T</i>	<i>E</i>	<i>S, L</i>		<i>H, R, A</i>
9	<i>Ä</i>		<i>Ä, P, S</i>		<i>R, L, A, E, N</i>
10			<i>V</i>		<i>I, N</i>
11				<i>T</i>	<i>R, J,</i>
12					<i>A, R, U</i>
13					<i>N, L, A, S, H, R</i>
14	<i>U, Ä</i>		<i>G, L, D, P, S, K</i>		<i>H, (E), A, (S)</i>
15			<i>P</i>		
16			<i>T</i>		<i>L, (S), E</i>
17			<i>J, G, T</i>		<i>A, V, E, I, N, E</i>
18			<i>F</i>		<i>R, A, E, (V)</i>
19					<i>(ABCDEFG)</i> <i>in the</i> <i>alphabet</i>
20			<i>J, P, O, S</i>	<i>H</i>	<i>A, G, V, I, H, R</i>

The assessment report notifies (Appendix 2) that Michael learned many letters. In December, before the teaching period with speech synthesis had started, Michael could tell the name or sound of three upper case letters, A, S, and M. In May, and after the teaching period, Michael could tell the name or sound of 18 upper case letters.

Table 2 shows how Michael used letters and their sounds according to the field notes from lessons 1-20. The intention with the table is to give an overview of Michael's development of letter knowledge during the period.

Column 1 contains letters which Michael, according to the field notes, did not manage to sound out when he tried to write a word, and whose letter symbols

he could not find on the keyboard. The teacher then usually showed the letter on the keyboard or wrote the letter or the whole word on a piece of paper. Column 2 contains letters which Michael succeeded to sound out together with the teacher, who often exaggerated the sound, and Michael joined in. He did not pronounce the sound independently, and he did not find it on the keyboard. Column 3 contains letters which Michael could sound out by himself, although he could not find the letter symbol. Column 4 contains letters which Michael could not sound out, but when the teacher sounded out the letter for him, he found it on the keyboard. Column 5 contains letters which Michael could sound out, and whose letter symbols he found on the keyboard. A letter in bracket means that it was not quite clear from the field notes that Michael knew the letter and its sound. For example, Michael possibly knew the letters in a certain name, but not in other contexts.

Table 3 shows how Michael used letters and their sounds according to the videotape from lesson 20. The videotape naturally provides a more thorough and complete description of what happened during the lesson than the field notes do.

Table 3. Letter knowledge according to the videotaped lesson 20, Case 1

Lesson	1.	2.	3a.	3b.
	M cannot sound out the letter and does not find it on the keyboard	M can sound out but does not find the letter	M can sound out and finds the letter but must look for it a long time	M can sound out the letter and finds it almost immediately
20		J, O, S	H, P, M	A, G, V, I, N, E, H, R

In lesson 20 Michael could sound out the words and find the letter sounds. Column 1 in table 3 was empty, and there was no need for a column for sounding out only together with the teacher, and neither for a column for knowing the letter only when the teacher has sounded it out. Column 2 corresponds to column 2 in Table 2. Column 3a and 3b correspond to column 5 in table 2. It was possible on the videotape to distinguish between two types of letter knowledge: when Michael had to look for the letter a long time on the keyboard, and when Michael found the letter almost immediately. Table 3 which is built on the videotape from lesson 20 has some notations that are not found in the row for lesson 20 in table 2, which is built on field notes.

6.2.6 Development of letter knowledge according to tests

In the pre-test Michael recognized three upper-case letters and no lower-case letters, and he could write six upper-case letters and three lower-case letters. In

the post-test he recognized eighteen upper-case letters and eight lower-case letters. He could write eight upper-case letters and four lower-case letters.

A letter check was done shortly after his first school year began, that means more than three months after the project. At that time, he recognised almost all letters, 26 upper-case letters and 25 lower-case letters (Appendix 2).

6.2.7 Summary of development of letter knowledge

Michael learned many letters during the research period. He heard both the teacher and the speech synthesis pronounce letter sounds when he was working on a word. He saw the graphemes both on the keyboard and on the screen, and later the print-out. He had many opportunities to make connections between phoneme and grapheme.

For the letters <R>, <N>, <V>, and <E> there is a clear pattern of development. They appear in the first columns in the earlier lessons, and in the later lessons they appear in the last column, or in the two last columns in table 3. Michael could not sound out these letters in the earlier lessons, or he could sound them out, but he did not know what they looked like. Then, in the later lessons, Michael could sound the letter out and he also knew what it looked like. Learning of the letters had occurred during the period.

The letter <S> appears in a different pattern. It appears in the third and fifth column in table 2, but there is no clear line of development. It appears in the third column, then in the fifth, then in the third again, then in the fifth, and then in the third. Michael can sound out the letter, but sometimes he finds it on the keyboard, and sometimes not. Even in the last lesson he could not find <S> on the keyboard. Michael could find and pronounce the sound /s/ in a word, but he seemed not to be sure what the letter <S> looked like. Strangely enough, according to the psychologist's statement, <S> was one of three letters which Michael knew when the project started.

The letter <O> appears only in the last lesson, but it appears many times there in the field notes and in the video, and every time it is classified in column 2. Michael could sound <O> out, /u/, but he did not seem to learn what the letter looked like although he met it many times. The teacher's actions were not very scaffolding for the learning of the letter <O>, as she pointed to the letter without pronouncing it and then withdrew to writing fieldnotes.

Michael used letter sounds more often than letter names. On the video from lesson twenty he used the letter sounds, at least /v/, /d/, /r/, /h/, /p/, /n/, /m/, /a/, /e/ and /u/. He used letter names a couple of times. When he wrote the dog's name Nappe, he was going to leave it Napp, and he mentioned /pe/ for <p> (CD2MiL20Epi22), (6.2.2). When he was going to write "jag" (I), he said the name of the letter <j>, /ji/, or possibly, /i/, and he pressed the I-key, until the teacher sounded out /j/ and showed him the J-key. He also later used /ji/, the name of the letter <j> (CD2MiL20Epi7).

6.3 Development of Literacy skills: The Word as a Unit of Meaning

Michael had a great deal of work to do, when he was learning to distinguish a word as a unit of meaning in the continuous stream of speech. He did not always start to write from the beginning of a word.

6.3.1 To start with the first vowel or with the first sound?

Michael sometimes, especially in the early lessons, wanted to begin a word with the first vowel and not with the first sound. In the first lesson he was going to write the names Nappe, Klas and Tanja, and he said for each one of them: “it begins with a”. When the teacher pronounced the names and exaggerated the first sound, Michael found the real first sound in the words (L1.1.37-39, L1.2.8-13), as in the description of his writing of “Nappe” in chapter 6.2. <A> was one of the few letters which Michael knew when the project started, and perhaps it was easier for Michael to perceive /a/ than the sounds of other letters that were more foreign to him.

Michael also suggested other vowels than <a> for the first sound. When he was going to write ‘Dummer-Jöns’ (L4.1.20), he suggested /æ/ first, and /d/ only after that. The same thing happened when he was going to write ‘Robocop’ (L5.1.17-18), he suggested /o/ first, and, after that, /r/. The vowel was possibly easier to perceive than the consonant. On the contrary, there are also examples when Michael left the vowel out. When he was going to write “Vinni”, the name of a dog, he wrote VNNI, (L7.5-7), and for “var”, (was) he wrote VR (CD2MiL20epi28).

Even in the last lesson there are examples where Michael suggested the first vowel instead of the first sound in a word. When he was going to write “jag” (I), he suggested /a/ for the first sound in the word. (CD2MiL20epi6). He suggested /e/ for the first sound in “Helsingfors” (Helsinki) (CD2MiL20epi12) and /u/ for the first sound in “hos” (at) (CD2MiL20epi33).

A strange thing is that Michael often had difficulties in later finding the vowel in its right place in the word. For example, in the case of Helsingfors, where he had suggested /e/ for the first sound and then found /h/ with some help from the teacher, it was difficult for him to find /e/ again. The teacher asked him to take “that which you just said”, but Michael suggested /h/ and /s/, the last sound, until the teacher gave in, and wrote the name Helsingfors on a paper to him to copy from (CD2MiL20epi12).

When Michael was going to write “hos”, he started with suggesting /u/ to the first sound. He found /h/ with some help from the teacher, but after that he did not suggest /u/ again. The teacher tried to remind him with “one which you already have said”, but without success, and the teacher eventually pointed to the O-key. The transcription of this episode on the video can be found in chapter 6.2.3.

The two examples above are both words with <h>, which is a difficult sound (Taube, 2007), like a breathing only, and that might make the whole word difficult to handle. However, difficulties of the same kind appeared in the word “jag” (I) (CD2MiL20epi6,7). When Michael had suggested /a/, the vowel, to the first sound in “jag”, the teacher pronounced the word many times with stress on /j/, and then Michael sounded out /j/ and wrote <j>. He suggested <g> to the next letter, and the teacher said that there should be another one also. Michael suggested another <j> twice, and the teacher said three times that he already had said the right letter. Eventually, after the teacher had pronounced “jag” with an exaggerated long /a:/, Michael found /a/ again.

It is not easy to understand why it was so difficult for Michael to find the vowel again, when he already had suggested it, only too early. A possible explanation could be that he had experienced a failure and avoided to say the vowel a second time.

6.3.2 To start from the beginning or from the end?

Sometimes Michael began to write from the end of the word and not from the beginning.

When he was writing the name Jöns, the second part of “Dummer-Jöns” (L4.1.38-40), he started to sound out from the end of the word: “s, n”.

He was writing the name of his friend Emilia (L6.1.6-23), and he had started from the beginning of the word and had written EM. Then he started to sound out from the end of the word, he said /a/, and the teacher interrupted him. He returned to the beginning of the word and wrote <I>, so the result was EMI. Then he again sounded out from the end of the name and wrote <A> so the result was EMIA.

When Michael and the teacher played a Hangman game with speech synthesis some days before Easter (L12.16), the teacher had written the word “påsk” (the Easter) for Michael to try to guess, and she told him that the word is a holiday. Michael guessed letters: i, s, k, å, p, in that order. After a random guess of <i>, he started to guess the letters in “påsk” from the end of the word.

In the videotape from the last lesson, there are not so clear examples where he had tried to start writing from the end of a word, as in the first lessons. However, there are some tendencies. When he wrote “Helsingfors” (Helsinki) and had difficulties in finding <e>, he made a guess from the end of the word: /s/ (CD2MiEpi12). When he was writing “mommo” (granny) and had already written <MO>, he tried to go on writing <O>, and suggested <O> many times, which is described in chapter 6.2.3. He was probably working on the last sound in the word, /u/, even if the teacher did not understand it.

6.3.3 What is a word?

Sometimes Michael wanted to go to the next word too rapidly, when he had only written the first letter in the word which he was working on. When Michael should write “Jag och Anna” (me and Anna), he wrote <j>, the first letter in “jag”

(me), and then he started to sound out /o/ for “och” (and). (CD2MiL20epi7). When he was going to write “Vi var i Helsingfors” (We were in Helsinki), he started with “vi”, and when he had written <V> for “vi” (we), he started to sound out /va:/, the first sound in the following word “var” (were) (CD2MiL20epi27). Then, when he was writing “var”, and had written <v>, he started to sound out /i/ for the following word “i” (in) (CD2MiL20epi28). It seems that Michael thought that he had finished the word when he had written a letter.

There is also an example where he was writing a word with two syllables, and when he had written the first letter, he started to sound out the last sound in the word. He was writing “heter” (is called) (L8.1.17-19). He wrote <H>, but after that he suggested /r/, the last sound in the word. Maybe the first and the last letter seemed to be enough for a word with two syllables.

Michael did not usually use the space bar on his own initiative to make spaces between words. Even when he copied text which the teacher had written after his dictation, he did not make spaces between words, although the text he copied had spaces. When he copied the sentence “Emilia kommer till mej idag” (Emilia will come to me today) which he had dictated to the teacher, the result was: “EMILIA KOMMER TILLMEJIDAG” (L6.5-27). He wrote “Emilia” without the model, and the teacher encouraged him to make a space after the word and possibly also after the second word, the field notes are unclear about that, but the last four words he wrote without a space between them. In lesson seven and in lesson nine Michael also copied parts of sentences (chapter 6.4), and the field notes tell that Michael had difficulties with the spaces.

Even in the last lesson, which is videotaped, Michael did not by himself make any spaces between the words. When Michael had finished a word, the teacher pointed to the spacebar every time, and only then he pressed the space, and made speech synthesis pronounce the word.

6.3.4 Word reading and writing

The teacher often gave Michael a print-out of his own text to read. When Michael wrote names of family members and dogs in the first lesson, he only managed to read his own name and his sister’s name. Later, he managed to read almost all names, and the teacher commented that he probably looked at the first letter in the words (L4). Michael read a list of the names of the dogs, which he had just written, but he mixed up the names. When the teacher sounded out the names, he managed to make synthesis and read the words, but not when he sounded out them himself (L8).

In some of the last lessons, he read a list of names on the screen, names which he had written earlier (L17), and also a short sentence which he had written only a little while ago (CD2MichaelL20Epi16). He read a relatively long sentence from the out-print, a sentence which he had written only some minutes ago: JAG OCH ANNA OCH PAPPA OCH NAPPE VAR I HELSINGFORS (I and Anna and Dad and Nappe were in Helsinki). At his first attempt, he left out “pappa” and “Nappe”, and at his second attempt he managed to read the sentence, except that he read “min pappa” (my dad) and not only “pappa” (CD2MichaelL20Epi30). He

succeeded in reading well-known words and sentences which he himself had written a short time ago.

According to the testing, Michael did not manage to read any words. The assessment report mentions only words with lower-case letters, so his ability to read words with upper-case letters was apparently not tested. The test at the school-start, three months after the second testing, reports that he managed to read almost all simple, one-syllable words, both with upper-case and lower-case letters (Appendix 2).

Word writing is dealt with in detail in 6.3.1 - 6.3.3. According to the assessment report, Michael wrote in an alphabetical way at the second testing. He succeeded in sounding out words, but because he did not know all letters, he did not manage to write the words phonetically correct. According to the report, he approached reading by writing (Appendix 2).

6.3.5 Summarising reflections

Michael was learning the characteristics of written language, for example that there are separate entities, words, with spaces between them in written language, although spoken language is a continuous flow. He did not usually make spaces between words on his own initiative, not even in the last lesson. Even when he copied a text, like in the example with Emilia above, he left the spaces out, especially between other words than proper nouns, nouns and verbs, like children often do (Tolchinsky, 2016).

When space bar was pressed, speech synthesis pronounced the preceding word. To hear speech synthesis pronounce the word he had written could be a nice experience for a child and hopefully lead to a better understanding of the word as a unity. The videotape from lesson 20 shows that the teacher silently pointed to the space bar when Michael had finished a word, and Michael then pressed the space bar and listened to feedback. The scaffolding function (Wood et al, 1976) is simplifying the task which gave auditory feedback on the word.

A second characteristic of written language is its directionality (Riley & Reedy, 2000). Michael sometimes started to sound out a word from the end, and not from the beginning. A possible explanation could be that the end of the word was fresher in memory than the beginning, when he or the teacher had pronounced a word,

When Michael was writing words, he often wanted to start a word with the first vowel and not with the first sound. The teacher then pronounced the first sound exaggeratedly, which means scaffolding with a modelling function. A special trait in Michael's work with words was his difficulties to find the vowel again, when he had once suggested it to be the first sound in the word. When he eventually found the real first sound with the help of the teacher, he had big problems with finding the vowel again, despite that he had already mentioned the vowel, only a few minutes ago.

6.4 Development of Literacy Skills: Writing a Story

Michael started with writing his own name (L1.1.13-15), and after that he wrote names of family members and friends. During the first four lessons he wrote only names, which was the first step in his development towards text writing.

The next step in development was when Michael started to dictate sentences and small stories for the teacher to write down. He copied most of the text, but he also wrote some words independently. When the teacher had suggested that Michael should tell the talking computer a story, he dictated: "I shall perhaps buy a film. A Robocop." The teacher wrote the sentence down, except the word Robocop, and Michael copied it. He wrote the word Robocop independently, using auditory feed-back, and with some help from the teacher (L5.6-28). In lesson six he also dictated a sentence, about Emilia, which is mentioned in 6.3.3.

Then he started to dictate not only a sentence but a whole story. In lesson seven he dictated several sentences in a story about a dog and the names of her puppies, and in lesson nine he dictated a story about a turtle. In cooperation with the teacher he chose a sentence which the teacher wrote down: "The turtle Lasse is in the same place almost all the time." He wrote the first part of the sentence, using auditory feed-back, and then copied "almostallthetime", with no spaces between the words until the teacher helped with that. (L9.2.20-32).

In lessons fourteen and seventeen Michael in cooperation with the teacher chose a short sentence, "Happy Easter" and "I don't know". He kept the sentence in his memory while writing it, using auditory feed-back and some help from the teacher. In lesson eighteen Michael dictated a longer sentence about a dog: "Raffel was outdoors for the first time", and he started to write it with no written text to copy.

In lesson twenty, the last lesson, Michael made a little story, consisting of two sentences: "I and Anna and Dad and Nappe were in Helsinki. We were in Helsinki at my grandmother's." (JAG OCH ANNA OCH PAPPA OCH NAPPE VAR I HELSINGFORS. VI VAR I HELSINGFORS HOS MIN MORMOR.) The teacher did not write the sentences down, so Michael and the teacher had to remember them. Michael usually remembered his sentences, maybe not in every detail, and when the teacher said the first, or the second, or the third word, he usually could tell what word was the next.

The teacher told Michael to make a full stop after his sentences. In lesson twenty when the teacher told him to take a full stop after the first sentence, he looked for it on the keyboard, and when he found it, he asked: - Is it that one? After the second sentence the teacher also told him to take the full stop, and this time she pointed to it on the keyboard (CD2MiL20, epi15, epi36).

6.4.1 Reflections on story-writing

Michael's text-writing developed step by step from writing names to writing a little story in the last lesson. in accordance with the proverbial phrase that the child's name is the gateway to literacy (Liberg, 1990; Tolchinsky, 2016, pp 150-

151). His texts had the character of small narratives (Alamargot & Fayol, 2009), with one exception: he made a list of numbers and letters in lesson nineteen. The sentences are all main clauses. Two sentences are built in a bit more complicated way with two modifiers, the sentence about the turtle and the sentence “we were in Helsinki at my grandmother’s”. The structure of his texts can be characterised as text-writing at stage one (Wengelin, 2013b).

When Michael started to write more than names, he began with dictating a sentence to the teacher (L5.6-7), L6.4-5). The sentence which he dictated had a shape which corresponded to the characteristics of written language, which fits in well with the theories of Berninger and Winn (2006) about a text generation, a linguistic representation in memory of the ideas of what the writer wants to tell.

In the early lessons the teacher wrote his dictation down on a paper, which served as a scaffold both for their ability to remember the sentence and for Michael’s spelling of words. In the later lessons Michael and the teacher remembered the sentences without text on paper. To use the terms of Berninger and Winn (2006) (figure 1, chapter 2.3), Michael transcribed his text on the keyboard using auditory feed-back, and with assistance from the teacher.

6.5 The Use of Auditory Feedback

Michael used auditory feedback from speech synthesis in cooperation with the teacher. In this chapter focus is on Michael’s actions, and in chapter 6.6 focus is on the teacher’s actions, even if the border between these two issues may be a little artificial.

In the first lesson the teacher showed Michael how he could get auditory feedback by using the F1-key for listening to the recent letter or letters, and the key F6 for listening to all the text he had written. Michael used F1 and F6 on his own initiative already in lesson 2. As soon as he had written a word, he pressed F6 to listen to all the text (L2.1.17,24,36).

Michael wrote ROBOCOP in lesson five, (L5.1.17-28) a slightly longer word than the names he had written before, and, according to the field-notes, the teacher “tried to let him write independently”. Now Michael used F1 in a systematic way, listened to what he had written, tried new letters, and listened to them. When he had written RO he ordered feed-back with F1. In cooperation with the teacher he found more letters to write, and when he had ROBO, and later ROBOKO, he ordered feed-back with F1 again to check the word which was emerging.

When he wrote the name “Emilia”, which is described in 6.6.3, he also used F1 in a systematic way to check his writing.

Michael wrote GLAD PÅSK (Happy Easter) (L14.14-31) and worked the words out to a great deal with the help of auditory feedback. When he was looking for a letter, the teacher only showed him the row on the keyboard where he could find

it. He had written <G> and was looking for <L>. and he tried almost all letters in the actual row, including <L>, and erased them as soon as he had heard them. According to the field-notes (L14.16), he then “lost his interest in it”. After he had sounded out /g/ again together with the teacher, he found <L>. Then he wrote <A>, sounded out /d/ and started to look for it. However, he looked in the wrong row at the keyboard. He tried <E>, <U>, and <Y>, all in the row above <D>, and erased them immediately after he had heard them. He sounded out /d/ again, but he was still searching in the row above where he found <P>, so the result was GLAP. He ordered feedback with F1, listened to the word “glap”, and erased <P>. He started to look for <D> again, and now he found it, and he completed his word to GLAD (happy) (L14.14-22). He had used auditory feed-back to find the letters and to correct the mistake with <P> instead of <D>.

When he had written “glad” (happy), he went on writing “påsk” (Easter). He sounded out /p/ and tried many letters in the actual row of the keyboard, <U>, <E>, <H>, <Å>, and he erased them at once when he had heard them. Then he tried <T>, in the same row, ordered feed-back with F1, and erased <T> after that. At last he found <P>. The teacher showed him <Å>, he sounded out /s/, tried a couple of letters, and then found <S>. He sounded out the last letter in “påsk”, /k/, but he took <G>. When speech synthesis pronounced PÅSG, he erased <G>, and, according to the field notes (L14.28), “lost his interest in it”. However, he found <K> at last, and ordered feed-back on his word PÅSK (Easter) and accepted it (L14.23-29). He had used auditory feed-back to find the letters, and he had used auditory feed-back to check if the word was correct.

Michael also used auditory feedback to make new words and to play with words, like when he was writing the name Dummerjöns and made new words of it after he had heard feedback on the beginning of the word, and like when he heard feed-back on his word MOO and made the comment that a cow says moo (6.1.3).

6.5.1 Summarising reflections

Michael could use auditory feed-back as a scaffold for his writing, already in lesson five with “Robocop”, and especially when he wrote the expression “Glad Påsk” (Happy Easter). He used auditory feed-back to find the right letter and to check the growing words during the process of writing. Nevertheless, there were also problems with his use of auditory feed-back. When he was searching for /l/, and tried out almost a whole row of letters, he also tried <L>, but he did not recognise the sound at first. Using auditory feed-back seemed to be a considerable effort for Michael. The field notes mention twice that he lost his interest, when he had tried to find a letter, but had found out from auditory feed-back that the letter was not the right one. In spite of these difficulties, Michael used auditory feed-back successfully on many occasions when he wrote words and sentences.

The use of auditory feed-back gave Michael an opportunity to correct mistakes immediately, for example to correct PÅSG to PÅSK (L14.28-29), two consonant sounds, /g/ and /k/, which can be difficult to differentiate for a novice writer

(Druid Glentow, 2006). The possibility to correct mistakes immediately is valuable for a developing writer (McLaughlin, Weber & Derby, 2013).

6.6 Scaffolding Writing

The teacher interacted with Michael and tried to give him the support he needed for writing letters, words and sentences. Descriptions of scaffolding are also included in the chapters which deal with Michael's learning of letters and his writing, because the context is so essential (van de Pol et al., 2010, p 186) that it is difficult to describe scaffolding without describing the task and the context in which it happened. Scaffolding is analysed with the starting point in scaffolding functions (Wood & al., 1976) and means of assisting performance (Tharp & Gallimore, 1988).

6.6.1 Scaffolding functions

Many examples of scaffolding functions appear in the findings presented in chapters 6.1.3, 6.2.4 and 6.3.4: recruiting to task, frustration control, modelling, and reductions of the degrees of freedom, i.e. simplifying the task. The example above (6.5) in which Michael wrote GLAD PÅSK (Happy Easter) is an example of how the teacher scaffolded his writing by reducing the degrees of freedom when she pointed to the row on the keyboard where he could find the letter he was searching for. Modelling is a scaffolding function which often occurred when the teacher pronounced the speech sound which Michael was looking for in an exaggerated way, like an "idealization of the act to be performed" (6.2.4).

In lesson twenty, on the videotape, a new type of scaffolding appeared: questioning, which is one of Tharp and Gallimore's (1988) types of means of assisting performance. Michael had declared the sentence which he wanted to write, but he did not start to write, and the teacher asked: - What were you going to write now? (CD2MiL20Epi5) The question had the function of getting Michael started with his writing, or recruitment to task in the words of Wood et al. (1976)

When Michael wrote his sentence, he tried to go on to the next word when he had written only one letter in the first word "jag" (I), and the teacher asked: - Have you completed "jag"? (CD2MiL20Epi7). When he wrote the word "var" (were), he was again going to start with the next word after writing only the first letter. Then the teacher asked: What were you going to write? (CD2MiL20Epi25). Both the questions had the function of keeping Michael on the track, which means direction maintenance, one of the scaffolding functions presented by Wood et al. (1976).

Feeding back is another of the means of assisting performance by Tharp and Gallimore (1988). The use of auditory feedback from speech synthesis can totally be classified as the assisting means called feedback.

6.6.2 The right amount of scaffolding

To find the right amount of scaffolding, not to help too much and not too little, is a dilemma. There are some examples when the teacher apparently helped too much. In lesson seven Michael was going to write “Vinni har fått valpar” (Vinni had puppies) (L7.5-11). He wrote the name Vinni almost independently, and then the teacher wrote the rest of the sentence on a paper, and Michael could copy it. Michael knew the letters <A> and <R>, and he could have written the word “har” without a model, if the teacher had helped him with the letter <H>. In lesson twenty when Michael wrote words with the letter <O>, (6.2.3), the teacher sometimes helped too much and just pointed to the letter on the keyboard, and sometimes she helped too little and left Michael struggling with the word “mommo” (granny).

There are also other examples where the teacher probably helped too little. When Michael was writing “inte” (not) (L17.10-14), he wrote INE, listened to feed-back, changed it to INEE, listened again and changed it back to INE. Then, according to the field notes, he did not know what was wrong, and he suggested another word. If the teacher had helped him with the letter <T>, he could have finished his word. To write “Glad Påsk” (Happy Easter), which is described in 6.5, was apparently also a challenge for Michael. He used auditory feed-back well, but he also met some frustration in his work, and “lost his interest”, so the teacher could have helped him a little more.

Still, the examples where Michael had the opportunity to write independently, use auditory feed-back and get help from the teacher when he needed, were more frequent, like the example with ROBOCOP in chapter 6.5 and EMILIA in 6.6.4. When he wrote LASSE, the name of a turtle (L8.24-32), he found the letters <L> and <A> by himself, and then he had some help from the teacher for the rest of the word. In lesson eighteen he wrote RAFFEL, the name of a dog. He wrote RA independently, he got some help to find <F>, he found <E> by himself, and then the teacher helped him with <L>, in a mix of independent work and assistance when needed (L18.1.2-9).

In the field notes there are several notations where the teacher remarked that she tried to let Michael work independently, for the first time in lesson five with “Robocop” (L5.17), then in lesson six with “Emilia” (L6.6), in lesson seven with “Vinni” (L7.6), and in lesson nine with “plats” (place) (L9.19). The teacher tried to withdraw and give Michael more responsibility for his writing. When Michael was writing “pappa” (Dad) and already had written <P>, it was almost a minute before he wrote <A>, the next letter, (CD2MiL20epi9). The teacher waited for his response and did not intervene. The description in 6.5 of Michael writing “Glad Påsk” (Happy Easter), trying out many keys to find the right sound, is also a description of the teacher’s withdrawal, which possibly was too extensive in that case. Withdrawal usually happened when Michael wrote single words, which were not too difficult.

6.6.3 Collaboration

Collaboration and a joint task engagement between the adult and the child are a core characteristic of scaffolding. The collaboration between Michael and the teacher is best studied on the video from lesson twenty. Michael decided what he was going to write, in the videotaped lesson (CD2MiL20Epi3-4) and in many other lessons (6.1.1), so he had at least to a great deal a common goal with the teacher for the writing activity. There are examples of collaboration in writing between Michael and the teacher below in 6.6.4.

There are also some examples of the opposite. When Michael struggled with the word “mommo” (granny) and with the letter <o>, the teacher wrote field notes and did not help him when he might have needed it. When Michael had written MOO for “mommo” (granny) and almost got stuck with it, he suggested <r> and “mor” for “mormor” (grandmother). The teacher was writing field notes, and Michael had to repeat his suggestion a couple of times before the teacher noticed it (6.2.3, CD2MiL20Epi35-36). The field notes from lesson twenty does not mention this, but the video shows that the teacher neglected the collaboration with Michael when she was writing field notes.

6.6.4 Scaffolding and repair

Sometimes Michael met problems or made mistakes in his writing, and corrections were necessary. The corrections were analysed with the concept of repair, (Schegloff, Jefferson & Sacks, 1977; Martin 2004), a special kind of scaffolding (Martin, 2004, p 187), which is used when there is a misunderstanding, a problem in communication, or the speaker is not satisfied with his or her utterance, or in writing, when the writer or the teacher is not satisfied with the text. There are sequences of repair of a word or an expression in which a development of repair organisation can be studied.

EMILIA

A sequence of and repair is found in lesson six when Michael was writing the name “Emilia” (L6.1.6-23) and had some problems with that. At first the teacher was more active and showed him what was wrong and helped him to correct it. In the end Michael himself noticed when something was wrong and changed it.

Field notes, L6.1.10-14:

Michael is writing the name “Emilia”, and he has already written EM. Then he starts to sound out the last letters in the name. The teacher suggests that he should order auditory feed-back with F1 on what he has already written. Michael follows the advice and listens to EM. After that he fills in the letter “I”.

The teacher interrupted him when he was going to start writing from the end of the word and told him to listen to auditory feed-back. After that Michael could add the correct following letter in the name. The organisation of repair is other-initiated self-repair.

Field notes, L6.1.14-20:

When M has written EMI he listens with F1, sounds out from the end of the word and writes:

EMIA

He listens to "Emia" with F1 and then deletes A. He tries to sound out the rest of the word. The teacher helps him to sound out L and I. He writes:

EMILA

Michael himself now took the initiative to listen to auditory feed-back on "EMIA", he noticed that something was wrong and deleted A. The teacher helped him to find the next sound, /l/, in "Emilia", and Michael wrote the letter <L>. Repair is self-initiated, and then repair is made by Michael and the teacher in collaboration, assisted self-repair. The repair organisation is self-initiated assisted self-repair.

Field notes L6.1.20-23.

M has written "Emila". He listens with F1, deletes A,

EMIL listens with F1 again, and adds I

EMILI listens with F1, adds A. He has managed to write:

EMILIA

Michael used feed-back to listen to his word, and he changed the word so the result was the name "Emilia". Michael now both detected the problem and solved it. The repair organisation is self-initiated self-repair. There is a sequence of development of repair organisation when Michael was writing the word Emilia, from other-initiation to self-initiation.

JAG VET INTE (I don't know)

In lesson seventeen there is another example of a sequence of repair. Michael was writing "jag vet inte" (I don't know) (L17.6-22), or "ja vet int", as he said in colloquial language. The teacher helped him much at first, but then Michael solved the words more by himself.

Field notes L17.6-9.

Michael is sounding j-a-g (I). He sounds out /j/. but he is going to press the I-key. The teacher points to J.

JA

Michael is going to stop when he has written JA, but the teacher sounds out "j-a-g" super-clearly. Michael sounds out G, is going to press K, but the teacher points to G.

JAG

Michael could pronounce the sound, /j/, but he was going to take the wrong letter, <I>, a letter with a sound which was close to the right one. The teacher pointed to the right letter, <J>, and Michael followed the hint. Repair is other-initiated, and Michael did the repair himself when he pressed the J-key, but the

teacher had pointed to the right key. The repair organisation is other-initiated assisted self-repair.

When Michael had written JA, he wanted to finish the word, but the teacher prevented him and pronounced the word “jag” (I), exaggerated the last sound and pointed to the letter <G> when Michael was going to take <K>. The repair organisation is other-initiated assisted self-repair, or maybe even other-initiated other-repair in both cases.

Field notes L17.10-14.

Michael starts to write “vet” (know). He sounds /v/ out, finds V, he sounds /e/ and finds E immediately, then he sounds /t/ out, but presses the P-key.

VEP Michael erases P, but immediately writes P again. He listens twice to “VEP” with F1. Then he takes another P.

VEPP He erases both the P:s and takes E.

VEE M erases E. With some help from the teacher he finds T at last.

VET

Michael found the first two sounds in the word, “vet” (know), and the corresponding letters, but when he was going to find the letter for /t/, he had problems. He tried various solutions, <P>, <PP> and <E>, and he noticed that they are not the right ones and erased the letters. He needed “some help” from the teacher, which meant that she drew a big T on a paper, and then he pressed the T-key. This is an example of self-initiated assisted self-repair.

Field notes L17.18-21

INE He listens with F1, takes another E

INEE He erases E

INE He listens with F1 to “INE” and with F6 to all the sentence “JAG VET INE” (I don’ know). He does not know what is wrong.

Michael suggests that he shall write “jag vet ingenting särskilt idag” (I know nothing special today) and erases E.

IN He listens with F7 and F1.

The teacher writes “ingenting” (nothing) on a paper for Michael to copy.

Michael wrote the beginning, IN, of the word “inte” (not), but then he wrote INE and not INTE. He tried various solutions, but he did not find the right one. Then he changed his intentions to another, longer word, and the teacher wrote the new word on a paper. With this change, the possibility to learn the letter corresponding to /t/ was lost this time.

Michael noticed by himself that there was a problem with the word “inte”, and he made a creative solution by choosing another word which the teacher wrote on a paper. The repair organisation is self-initiated assisted self-repair, although the solution was made in a somewhat surprising way.

The sequence of development in the example “jag vet inte” (I don’t know) goes from other-initiation to self-initiation, and repair is assisted self-repair in all cases.

VAR (were)

On the video from lesson twenty there is also a sequence of repair. Michael was writing the sentence “Vi var i Helsingfors hos min mommo” (we were in Helsinki at my granny’s). He was working with the word “var” (were), and he wrote VR. The problem source here is that he left out the vowel, and also that he wanted to move forward and begin with the next word too early.

CD2MiL20Epi27

- | | | |
|-----|--|--|
| VR | <i>B: Minns du vilken du ska lyssna med?</i> | <i>B: Do you remember with which one you should listen?</i> |
| | <i>((M tar F1, talsyntesen uttalar VR))</i> | <i>((M takes F1, speech synthesis pronounces VR))</i> |
| | <i>((M rör händerna över tangentbordet, raderar R))</i> | <i>((M moves his hands over the keyboard, erases R))</i> |
| | ---- | |
| V | <i>M: I. I måst de va.</i> | <i>M: I. It must be I.</i> |
| | <i>B: Prova</i> | <i>B: Try it</i> |
| | <i>M: i</i> | <i>M: i</i> |
| VI | <i>((M trycker på bokstaven I. Talsyntesen uttalar I))</i> | <i>((M presses the letter I. Speech synthesis pronounces i))</i> |
| | <i>M: Helsingfors</i> | <i>M: Helsinki</i> |
| | <i>B: Var. Vi var.</i> | <i>B: Were. We were.</i> |
| | <i>M: Var, r.</i> | <i>M: Var, r</i> |
| VIR | | VIR |

The teacher reminded Michael of listening to auditory feed-back, and when he listened to V-R, he understood that there was a problem. Repair was other-initiated. Michael wanted to move forward in the sentence and suggested “i” (in) and “Helsingfors” (Helsinki), and the teacher pronounced the word, “var”, with stress on /r/. Michael wrote VIR. Repair was assisted self-repair, but the result was not “var” (were) as it was supposed to be. The teacher encouraged Michael to make a repair once more.

- | | | |
|-----|---|---|
| VIR | <i>B: Minns du vilken du ska lyssna med?</i> | <i>B: Do you remember with which one you should listen?</i> |
| | <i>((M tar F1. Talsyntesen uttalar VIR.))</i> | <i>((M takes F1. Speech synthesis pronounces VIR))</i> |
| | <i>((M och B ser på varann.))</i> | <i>((M and B look at each other))</i> |
| | <i>B ((viskar)): va sa den?</i> | <i>B ((whispering)) what did it say?</i> |
| | <i>M: Vir</i> | <i>M: Vir</i> |
| | <i>B: Ja ((småskrattar))</i> | <i>B: Yes ((laughing))</i> |

	<i>M: Vi var</i>	<i>M: We were</i>
	<i>B: Det ska vara "var".</i>	<i>B: It is supposed to be "were"</i>
	<i>B: Du måste ta och ändra på det nu</i>	<i>B: You must change it now</i>
	<i>Så det blir "var"</i>	<i>so it will become "were"</i>
	<i>((M raderar R))</i>	<i>((M erases R))</i>
VI	<i>M: Nu ska vi si</i>	<i>M: Now let's look</i>
	<i>B: Ta bort en till</i>	<i>B: Erase another one</i>
	<i>((M raderar I))</i>	<i>((M erases I))</i>
V	<i>B: sådär.</i>	<i>B: like that</i>
	<i>M: och sen A</i>	<i>M: and then A</i>
	<i>B: ja</i>	<i>B: yes</i>
VA	<i>((M trycker på A som talsyntesen uttalar))</i>	<i>((M presses A, speech synthesis</i>
		<i>pronounces it))</i>
	<i>M: I</i>	<i>M: In</i>
	<i>B: Va va de du sku skriva?</i>	<i>B: What were you going to</i>
write?		
	<i>M: Vi va i ((Trycker på I))</i>	<i>M: We were in ((Presses I))</i>
VAI		

The teacher again reminded Michael to listen to auditory feed-back, so repair was other-initiated. Michael noticed that he had not written the word he had intended to write but something else, and he pronounced the word "var" (were) clearly. The teacher assisted when he erased letters in VIR. Michael knew that <A> was the missing letter, but then he moved on to the next word, "i" (in), so the result was VAI and not VAR. The repair organization was other-initiated assisted self-repair, but Michael had not yet managed to write the word, and he had to make a third repair.

VAI	<i>[B: Jo men du ska ha...</i>	<i>[B: Yes but you should have...</i>
	<i>[B trycker på F1 och talsyntesen uttalar "Va-i"</i>	<i>[B presses F1 and speech synthesis</i>
		<i>pronounces "Va-i"</i>
	<i>B: Du ska ha var först. Var.</i>	<i>B: You shall have "var" first. "Var"</i>
		<i>(were).</i>
	<i>B: Om du tar bort...(B raderar I)</i>	<i>B: If you erase...(B erases I)</i>
VA	<i>B: Det kommer nog I sen, det gör det,</i>	<i>B: "I" will come later, it will,</i>
	<i>men du ska ha "var" färdigt först.</i>	<i>but you are supposed to finish</i>
		<i>"var" before that.</i>
	<i>M: Var</i>	<i>M: Var</i>
	<i>B: Ja</i>	<i>B: Yes</i>
	<i>((M trycker på R som talsyntesen uttalar))</i>	<i>((M presses R, speech synthesis</i>
		<i>pronounces it))</i>
VAR	<i>B: Fint</i>	<i>B: Fine</i>

The teacher ordered feed-back and even erased a letter, so repair was really other-initiated. Michael made the final repair when he pronounced the word and inserted <R>. The repair organization is other-initiated self-repair.

When Michael worked on the word “var” (were), repair was other-initiated all three times. The teacher encouraged Michael to order auditory feed-back when he had made a mistake. Repair was assisted in the first two cases and in the last case Michael did the repair by himself.

Table 4 shows the repair organisation in the examples above.

There is a development in the repair organisation from other-initiation to self-initiation and from assisted self-repair to repair. In two examples of repair sequences, “Emilia” and “jag-vet-int” (I don’t know), there is a development from other-initiation to self-initiation. In the third example, “var”, all initiations are other-initiations. The development which is found in the third sequence is from assisted self-repair in the first two cases to self-repair in the third case.

Table 4. *Repair organisation, Case 1*

Sequence	Repair organisation	Lesson	
Emilia	EMA - EMI	Other-initiated self-repair	L6
	EMIA - EMIL	Self-initiated assisted self-repair	
	EMILA – EMILIA	Self-initiated self-repair	
Jag vet inte (I don’t know)	I - J	Other-initiated assisted self-repair	L17
	JA - JAG	Other-initiated assisted self-repair	
	VEP – VET	Self-initiated assisted self-repair	
	INE – INGENTING	Self-initiated assisted self-repair	
Var (were)	VR - VIR	Other-initiated assisted self-repair	L20
	VIR - VAI	Other-initiated assisted self-repair	
	VAI - VAR	Other-initiated self-repair	

6.6.5 Summarising reflections

Most of the scaffolding functions described by Wood, Bruner and Ross (1976) are found in the interaction between Michael and the teacher: recruiting to task, frustration control, modelling, reductions of the degrees of freedom and direction maintenance. Questioning, one of Tharp and Gallimore’s (1988) assisting performances, appears in the last lesson with the scaffolding functions of recruitment to task and direction maintenance.

The examples in chapter 6.6.2 describe the dilemma for the teacher to give the right amount of scaffolding, not too little and not too much. A core characteristic of scaffolding is contingency, which means that the support given to the learner is adapted and adjusted to the competence of the learner and to the task. Another core characteristic is withdrawing, (Stone, 1998; van de Pol et al 2010), and

examples when the teacher withdraws are also found in chapter 6.6.2. A third core characteristic of scaffolding is a joint task engagement, with both the child and the adult actively working to a common goal in a collaborative way (Masters & Yelland, 2002). There are many examples of collaboration and joint task engagement between Michael and the teacher, but there are also examples in 6.6.3 when the teacher fails to collaborate because of writing field notes.

Sequences of repair are found in the material. Repair is a special kind of scaffolding, which is used (Martin, 2004) when there are some kinds of problem in communication, or the speaker, or the writer, is not satisfied with his utterance. The examples with “Emilia”, “jag vet inte” (I don’t know) and “var” (were) have a structure which describe a development in repair organisation. The development was from other-initiation to self-initiation of repair when Michael wrote “Emilia” and “jag vet inte”, and from assisted self-repair to self-repair in the word “kan” (know).

6.7 Summary of Case 1

Michael did not always want to write, but he was interested in the computer and in listening to speech synthesis. He started with writing names, after that he dictated small sentences to the teacher, and in the last lesson he wrote two sentences.

He knew only a few letters when the research period started. When he was going to write words with auditory feed-back during the lessons, the teacher often pronounced the phonemes in an exaggerated way, and he joined the pronunciation. The scaffolding function was modelling. Michael looked for corresponding letters on the keyboard, sometimes with help from the teacher. The scaffolding function was simplifying the task. When he chose a letter, he heard auditory feedback and saw the letter on the screen. He had many opportunities to make a connection between phoneme and grapheme. In the last lesson he knew many letters, but he did not learn the letter <o> although it occurred many times during that lesson, which can be connected to the teacher’s neglect of modelling and early withdrawal.

Michael often managed to sound out words, but it was difficult for him to find the corresponding letters, especially in the early lessons. When he wrote words, he sometimes tried to start with the first vowel and not with the first sound, and sometimes he tried to start from the end of the word. When he had incorrectly suggested the vowel for the first sound and after that found the real first sound in a word, he sometimes had difficulties in finding the vowel again.

Michael often used auditory feedback independently with F-keys after the first lessons, and he also used auditory feed-back to play with words and to create new words.

Many of the scaffolding functions which Wood et al. (1976) described occurred, and the core characteristics of scaffolding were also found, even if

there also were problems. Examples were found of repair, a special type of scaffolding, with a tendency of development towards independency.

7 Writing Sentences and Reading Words. Case 2

The principal character in case two is Marc, seven years old when the project started and in the first grade. He wrote words and texts with auditory feed-back from speech synthesis in cooperation with a teacher, once or twice a week from October to February. In some lessons, he also made words with letter cards.

Marc knew many upper-case letters when the project started, and almost as many lower-case letters (appendix 4). He knew how to spell his own name and knew the initial letters in the names of some family members, but he could not write much more than that. He did not manage to read words.

Eighteen lessons were given with a mean length of thirty minutes. There are videotapes from two early lessons, lesson four and six, the total time 41 minutes, and a from a late lesson, lesson 15, of 29 minutes. In the first lessons Marc used upper case letters. The teacher tried to make him use lower case letters (L3.1.6), and he did so for some time. Then, (L5.1.5, L7.1.13), he said that he wanted upper case letters. In lesson ten, he for the first time did not demand upper case letters (L10.2.31), and after that he wrote words and texts with lower case letters. In this text, Marc's own writings are written with upper-case letters in early lessons, and when Marc began to use lower-case letters, his text is underlined. When longer texts are cited, they are written with italics.

References to the field notes are marked with the number of the lesson, page and line, for example (L3.1.6). References to the videotapes are marked with the number of the CD, the name of the child, the number of the lesson and the number of the episode, for example (CD4MarcL6epi4).

Chapters 7.1, 7.2, 7.3 and 7.4 deal with the development of basic literacy skills, the first research question. Following aspects of literacy development are presented: willingness to write, knowledge of letters, word reading, word writing and story writing. Chapter 7.5 deals with the use of auditory feed-back, the second research question. Chapter 7.6 describes how the teacher scaffolds the child's writing, the third research question.

7.1 Development of Literacy Skills – to Find the Urge to Write

In the first lessons Marc wrote random letter strings, and he listened when speech synthesis pronounced them. Sometimes the letter string resembled a word, like sab (L1.7), which resembled a make of car, Saab, and he listened to the word and commented it. When he had written WZO (L2.8-9) and listened to the auditory feed-back on it, he said: - It said zoo. He then wrote more letter strings, and when he had written WIN (L2.15-16) and listened to it, he said: - I know what it is, you can drink it. Speech synthesis pronounced the letter string WIN like the

word “vin” (wine). In lessons four and five the teacher had brought letter cards, and she suggested that Marc should make words with the cards. He made random letter strings also with the letter cards, like CÖTZ and MÖSZ (L5.12-27).

Marc also wanted to write his own name and names of family members, and he was acquainted with the word “och” (and) (L2.22). His list of names of family members was used as a reading task in following lessons.

7.1.1 Finding something to write about

Marc had not written any other words than letter strings and names until lesson six. The teacher asked him what he wanted to write, and he answered that he did not know. After some reflection, he, anyhow, suggested the word “mandel” (almond), and he wrote it with assistance from the teacher and from auditory feed-back (CD4MarcL6epi4). During the following lessons, Marc made suggestions of his own about what he wanted to write, and he mostly suggested names of things in the room, for example “väska”, (bag) (L7.1.12), “korg” (basket) (L7.1.2-3) and “lampa” (lamp) (L8.5-1.2). He wrote the words with some help from the teacher and from auditory feed-back. When he noticed that he had written many words, he exclaimed: - I have written eight words today! (L8.2.16).

A new theme appeared in lesson ten. He had spoken about his family’s activities during the recent New Year’s Eve, and he wrote words related to that: raket (firework), and taxi (L10.2.1-23).

In lesson eleven, Marc for the first time wrote a whole sentence, and, as a matter of fact, even two sentences. He had told the teacher about a family skiing tour, and according to the field notes (L11.1.1) “he talked pretty much”. He accepted a suggestion from the teacher to write about the trip, and he wrote: vi var och skidade till öjbärget. sen for vi hem. (we went on a skiing tour to öjbärget. then we went home). The field notes mention (L11.1.39) that he liked to listen when speech synthesis read out whole sentences. In the following lesson he started to write a text about a birthday party he had attended, and he wrote a story about the birthday party during two more lessons.

In lesson fifteen, which was videotaped, the teacher asked him what he wanted to write. He avoided the eyes of the teacher, looked at the computer screen and yawned (CD1MarcEpi3). Then, however, he started to talk about his football team and about a football match that was going to happen the following week. After some hints from the teacher, he decided to write about his hobby: football. With a smile he started to write about the coming match, and he said that next time he would write about the result of the match, a victory or a loss. During the three following lessons, the last lessons, he wrote about the football match and about the goal he had scored.

Marc began with writing strings of letters, then his own name and names of family members. He went on writing words that were names of things in the room and, after that, words that related to a pleasant activity. He did not write any complete sentences until lesson eleven. But then, when he had found an interesting subject, and he had talked about it with the teacher for some time, he was willing to write a little story about it.

7.1.2 Playing with words

In the first lessons Marc wrote random letters in a playful way, listened to their sounds from speech synthesis, and sometimes, almost by accident, a word was made up, like ZXO (L2.1.8-9), Zoo, and WIN (L2.1.15-16), “you can drink it.” He sometimes commented the sounds of speech synthesis with a great deal of imagination. He had written (L3.1.38) mnnnnnnmm and declared that it sounded like a ghost.

When he was writing names of things in the room, he sometimes made new words from the word he was writing. He was writing “lilla” (small) (L8.1.9-12), and he had written LI. He tried to write the rest of the word, first he tried “LIRRA”, and then “LIMM”. “Det är lim!” (it is glue), he exclaimed, and ordered feed-back once more on “LIMM”. When he had written the word “lilla” and some other words, he said that he wanted to write “lim” (glue), and he did so (L8.1.20-21).

When Marc was going to write “jul” (Christmas), he suggested Q, wrote Q, listened to it and erased it (L8.1.37-39). Then he said “kul” (funny), which would have been close to the pronunciation of QL.

He had decided to write “korg” (basket) (L9.1.3-10), and with some help from the teacher he had written the first part of the word: KO. He listened to speech synthesis and said that it was “ko” (cow). With some more help from the teacher he succeeded to write KOR, ordered feed-back twice, and said that it was almost “korv” (sausage). The teacher helped him to find the last letter ‘g’ in “korg” (basket).

After that he wrote the words (L9.1.11-12) that he had found out when he wrote KORG. He wrote KO (cow) and ordered feed-back on it. Then he wrote KORV (sausage) and ordered feed-back.

Marc could make up new words and play with letters and words, although he could not read out words (7.3) in a conventional way. He tried to read some words like “lamp” and “ball” that he had written the lesson before, but he did not manage to do it (L9.1.1-3), although he could tell the names of the letters. However, in the same lesson he created two new words out of the word “korg” (basket).

7.1.3 Summarising reflections

Marc wrote letter strings during the first lessons, randomly, it seemed. The teacher gave him letter cards to work with and apparently tried to lead him away from his letter strings to more conventional word writing, a scaffolding function of recruitment to task. However, when Marc wrote letter strings, he also in that way explored letters and their sounds. He explored letter combinations and their pronunciation, which also was a kind of preparation for reading and writing. Nevertheless, when Marc had written letter strings for some lessons, it was time for him to proceed to word writing.

At first, it took a long time for Marc to find out real words that he was going to write, for example in lesson six, when he said that he did not know what to write,

and then was silent for a while until he mentioned “mandel” (almond). In the following lessons he mentioned and wrote more words, more rapidly. When he made the comment in lesson eight that he had written eight words, he also made a comment on his own competence as a writer.

Marc began to write whole sentences and stories after he had told the teacher about events that were interesting to him, like a birthday party and a football match. He had found an interesting topic, which made him more willing to write.

7.2 Development of Literacy Skills: Knowledge of Letters

Marc knew the name of many letters already in the first lessons (appendix 4), but he could not always find the letters and their sounds when he was going to write or read a word. Sometimes he could tell the names of all the letters in a word without being able to read it.

When he wrote the names of family members in the second lesson, he could, with some help, sound out the letters <S>, <A>, <N>, <E>, and <I>, and he found them on the keyboard (L2.19-35). He also worked with the letters <T> (L2.29) and (L2.6), but he needed more help with them. In lesson three he used the same letters again, and the letter <m> also, and now in lower case (L3.13-38).

The videotapes show more clearly than the field notes what Marc could do on his own and how much the teacher helped, whether he could pronounce the sound and find the letters on the keyboard, or the teacher did it for him. The videotapes also show how Marc pronounced the letters, whether he used the name or the sound of the letter, which the field notes often do not tell. For that reason, Table 5, Overview of letter knowledge, is made on basis of the videotapes only.

There is a big difference between the two videotaped lessons four and six in table 5. In lesson four, Marc used the names of the letters much more than their sounds, for example /enn/ and not /n/ for the letter N. In lesson six, there is only one example when Marc used the name of the letter and not the sound, /ell/ for the letter L and not /l/. In all other cases he used the sound. In lesson fifteen, Marc used both the name and the sound of the letters.

Marc knew almost all letters in lesson fifteen, but he had some problems with the letters b, d, and g, and he mixed them up. A second check of letter knowledge was made in lesson sixteen (L16.1.1-4, appendix 4), and Marc could then tell the names of all upper and lower-case letters besides ‘q’. In lesson seventeen, Marc still mixed up “d” and “g”, and he wrote “jad” for “jag” (I) (L17.1.24).

Table 5. Letter knowledge according to videotapes from lessons 4, 6, 15, Case 2

Lesson	1.	2.	3a.	3b.
	Marc cannot sound out the letter, does not know the name of the letter and does not find it on the keyboard	Marc can sound out or knows the name of the letter, but does not find the letter	Marc can sound out or knows the name and finds the letter, but must look for it a long time	Marc can sound out the letter or knows its name, and finds it almost immediately
4	O, N, E	O	I, N (enn), L (ell,, /l/,)	V (ve), C, (se), T (te), B (be), J (ji)
6		P (/p/)	D, (/d/), L (ell), P (/p/)	Ö, T (/t/), A, S (/s/), M (/m/), E
15	Problems with B, D, G: they are often mixed up		V (/v/, ve), T (te, /t/), E, F (/f/), Ä, R (ärr, äll)	M, A, I, D (de /d/) H (/h/), T (/t/), O, S (/s/, ess), E, Y, B (/b/, be), K, G, L (ell)

7.2.1 Summarising reflections

Marc used the names of the letters more in the early lessons, and later he used the sounds of the letters more. In lesson fifteen he used both the sounds and the names of the letters. When he used the names of the letters, problems with word writing could sometimes appeared. He was writing the word “mandel” (almond), and he had already written MAND. He sounded out the rest of the word, and suggested /ell/, the name of the letter L, as the next letter. His suggestion was logical, because MAND and /ell/ would have formed the intended word “mandel”. The teacher answered “almost” to Marc’s suggestion of /ell/, and then he changed it to /e/ (CD4MarcL6epi4). The same problem appeared in lesson 15 when Marc was going to write “hade” (had). He suggested /de/, the name of the letter D, for the second syllable in the word “hade” (CD1MarcL15epi7).

7.3 Development of Literacy Skills: Reading and Writing Words

In the first lessons Marc had difficulties in reading words, although he knew all the letters in the word. For example, he played with letter cards (L5.1.21-25) and, with a little help from the teacher, made a string of letters: MÖSS (mice). Marc tried to read it and sounded out the letters quite well: /m/-/ø /-/s/-/s/, but he did not manage to read the word. After that he tried to read a word which he had written the lesson before, also a word he first made with letter cards: SÖT (sweet). He sounded out /s/-/ø/-/t/, and then said: ödla (lizard) (CD4MarcL6epi1). Only when he had tried to read out the word many times in cooperation with the teacher, he managed to read “söt”. Later, he was going to read some words (L9.1.1-3) he had written in an earlier lesson and printed out, LAMPA (lamp), BOLL (ball) and BOK (book). He said the names of the letters, but he could not read the words. In lesson ten he wrote “stol” (chair), (L10.1.2-11) and some other names of things in the room, now in lower-case letters. When he had finished, he printed out his text and tried to read the words. He sounded out very well: /s/-/t/-/u /-/l/, and then said: “bord” (table) (L10.2.25-27). He did not manage to read words, even if he knew the letters.

When Marc started to write small texts, he succeeded better in reading. He wrote a story about a birthday party: (L12.1.1-47) “först for vi till jacks kalas. och han är 8 år.” (we went first to jack’s party. and he is 8 years). In the following lesson he read his text and according to the field notes (L13.1.3-4) “he could read the words fairly well”. In the videotaped lesson fifteen Marc also read his text about the birthday party (CD1MarcL15epi2-3), and the story now consisted of six sentences. Now he could read short words independently, like “for” (went) and “till” (to), but he needed help from the teacher to read longer words like “present” (gift).

When Marc wrote words, the teacher often helped him to sound out letters and to spell. When he wrote the names of family members in the first lessons, he knew the first letters, and the teacher helped him with the rest. Later, he wrote short words quite independently. In the videotaped lesson fifteen, he wrote words like “mot” (against) (CD1MarcL15Epi8) and “lag” (team) (CD1MarcL15Epi12) on his own, and he used feed-back from synthetic speech.

7.3.1 The word as a unit of meaning

Speech synthesis in the Ove word processing program pronounces the preceding word when the space bar is pressed. When Marc had written MANDEL (almond) and PAPPA (dad) in cooperation with the teacher, he asked if he was supposed to press space (CD4MarcL6epi4, epi5). He was aware of the use of space after a word. When he had written MAMMA (mum), he pressed space on his own initiative (CD4MarcL6epi6). In lesson eight, when he wrote many words which he had suggested by himself, the teacher reminded him of the space after every

word (L8.2.17). Although he knew about the use of the space, he failed to use it when he was eager to write.

In lesson fifteen, on the videotape, Mark wrote sentences. When he had written a word, he first ordered feed-back with F1 and listened to the word, then he made a space and listened to the word again. He took F1 and space on his own initiative after six words (CD1MarcL15epi6,7,8,11), and the teacher reminded him of the space after two words (epi 9, 10). Marc distinguished the words as entities in a sentence, when he many times ordered feed-back and pressed space after having written a word.

7.3.2 To start from the beginning or from the end?

When Marc tried to read a word, he sometimes started with the last letters. When he played with letter cards in L5 and tried to read the word MÖSS (mice), he started with sounding out 'SS' (L5.1.23-24), the last sound. When he tried to read the word "SÖT" (sweet), he started from the end of the word with <T> (L5.1.13-14). On the other hand, when he read well-known words, like the names of family members (L3.1.3-4) and the words MAMMA (mum) and PAPPA (dad) (L7.1.9-10) which he had written earlier, he started to read from the beginning of the word. In lesson seven he read out the word "MANDEL" (almond) that he had written during the lesson before, and the field notes mention especially (L7.1.8) that he started to read from the beginning of the word.

Sometimes he also tried to start from the end of the word when he was writing words. When he had decided (L10.1.14-21) to write the word "golv" (floor), he started with <v>, the last letter in the word, and went on with <l>. The teacher interrupted him by asking "what comes first in 'golv'?", and then he answered /g/. When he should write "jul" (Christmas) (L10.1.30-36), he started with <l> and wrote <j> after that. However, when he wrote the names of family members in the very first lessons, he started from the first letter in the name.

In lesson thirteen when he wrote about a birthday party, he started from the end of the word when he was writing some short words (L13.1.7). He wrote "iv" for "vi" (we) and "ne" for "en" (one), but he changed it after he heard speech synthesis pronounce it. When he should write "hem" (home), he started with <m>. When he wrote longer words, however, like "fanns" (there was) and "godis" (sweets) (L13.2.3-22), he started from the beginning of the word.

In the videotaped lesson fifteen he was going to write "vi hade match mot Smedsby" (we had a football match against Smedsby). When he was going to write "hade", he started with <d>, and after that <e>. Only after a long discussion with the teacher he found <h>, the first letter. With all other words in the sentence he started to write from the beginning.

Marc was writing Smedsby, the name of a football team and a village, and he had managed to write "smedsb", all letters in the word except the last one. The teacher tried to make a helpful question and asked: "What is the very last sound in Smedsby?" In the teacher's and in Marc's pronunciation of "Smedsby", /smessbyh/, there was a clear /h/-sound after the last vowel, <y> (CD1MarcL15epi9).

Marc answered /h/, but the teacher did apparently not understand that he referred to the last sound he heard. When the teacher went on asking for “the last sound”, Marc turned to the beginning of the word, and suggested <s>, <m>, <e>.

B: vad kommer allra sist i Smedsby?
B: What is the very last (sound) in Smedsby?
M: h. hå
B: Smedsby
M: sm, m
B: va *B: what*
M: sm
B: allra sist? *B: The very last?*
M ((viskar)): smess, s *M ((whispering)) smess, s*
B: allra sist, allra sist *B: the very last, the very last*
M: m, e
B: smess...
M: e
B: ...by
M: b, b, b
B: by ((håller kvar munnen i y-läge några sekunder))
((B keeps her mouth in the y-position for some seconds))
M: y
B: fint ((nickar)) *B: fine ((nodding))*
M tar y, M tar F1, Ove uttalar "smedsby:"
M presses y, M presses F1, Ove pronounces "smedsby"
M: Smedsby ((ler, vänder sig mot B))
M: Smedsby...((smiles, turns to B))

In the word “Smedsby”, Marc started working with sounds at the beginning of the word, when the teacher asked for the last letter and was not satisfied with his suggestion <h>. His suggestion for spelling the word “Smedsby”, Smedsbh, was phonetically not at all a bad approximation of the colloquial pronunciation of the word. Only when the teacher did not approve of his suggestion for the last sound, he turned to the beginning of the word instead.

The directionality of print was still a problem for Marc. After lesson five he did not try to start reading a word from the right, from the end, but he could try to start writing from the end of a word even in late lessons. There was a variability in his work, sometimes he started to write a word from the beginning, from left, sometimes from the end, from right.

7.3.3 The vowel first, or only consonants?

When Marc was writing a word and tried to find the sounds and letters for it, he sometimes started with the vowel. When he had decided to write the word “lampa” (lamp) (L8.1.1-3), he started to sound out the vowel /a/. The same thing

happened again when he was writing the word “boll” (ball) (L8.1.4-6): he first sounded out the vowel /o/. In both cases the teacher interrupted him with the question “What does the word begin with?”, and then Marc found the first sound in the word. After that he was going to write the word “spel” (game) and now he did not start with the vowel, but with /sp/, the first sounds of the word.

He had suggested /o/ for the first sound in “boll” (ball), and only with some help from the teacher, he found the initial sound /b/. When he went on writing the word, he had difficulties in finding /o/ again, although he recently had sounded it out (L8. 1.17).

When Marc was going to write (L11.1.3-14) “vi var och skidade” (we were skiing), he wrote only i for “vi”. After some hint from the teacher he erased <i> and managed to write vi (we). When he started to write “var” (was), he only wrote a, and after that he tried to start writing the following word, “och”. The teacher encouraged him to listen to auditory feedback from speech synthesis, and then he noticed that he had written only a and not “var”.

The same thing occurred a couple of times later. He was going to write “for” (went) (L12.1.10-13) but he wrote only an <o>, and he ordered auditory feedback four times on his o, until he erased it and wrote for. In lesson thirteen he was going to write “där” (there), but he started with <ä> and <a> (L13.1.29-34). He also wrote for (went), but now he had no difficulties like those in lesson twelve, when he almost got stuck with the vowel <o> as the first sound. After lesson thirteen, however, there are no examples of that kind.

Sometimes Marc had difficulties in finding any vowel at all when he wrote a word. When he was writing “stol” (chair) (L10.1.2-11) and had a hard time with the first two consonants, the result was stl. Speech synthesis pronounced it as a string of letters, s-t-l, and it was easy for Marc to notice that something was wrong. When he was going to write “hem” (home) (L11.1.36), he first wrote only hm, and then immediately changed it to hem after listening to auditory feedback. He was going to write “kalas” (birthday party) (L12.1.24-27), and he started with kl. He ordered feedback with F1, and then rapidly erased <l>, and went on writing the word. When he was going to write the word “raket” (firework) (L10.2.3-8), he started with rt, the first and the last letter, and then he listened to auditory feedback and changed his word. In chapter 7.3.4 about words with two or even three consonants on a string, there are also examples when he tried to write a word without a vowel.

7.3.4 Difficulties with two consonants

Marc often had difficulties in writing words with two consonants in a cluster. When he was going to write “stol” (chair) (L10.1.2-8), he started with so, ordered feedback twice, and added an <l>, so he had sol. Then he listened again to feedback, and added a ‘t’, but placed it as the last letter in the word, so the result was solt. When he had listened to feedback he erased letters so only the letter <s> was left. He then wrote a <t> and listened to st. He had now managed to write the beginning of the word with two consonants, but he had still problems. Now

he did not write the vowel <o> but went directly to <l>', and had stl, which is also mentioned in the passage above.

He was going to write "skatt" (treasure) (L13.1.25-27), and he started with sat. He ordered feed-back twice on "sat", erased the two last letters, and wrote a 'k' so he had sk. Then, just like with the word "stol", he did not write the vowel, but the next consonant, so the result was skt. When he heard the speech synthesis say "s-k-t", he could change it and gradually produce skatt.

Later he wrote "present" (L14.1.9-11) and the name Smedsby (CD1.MarcL15Epi9.) without any problems with two consonants at the beginning of a word. The word "stolpen" (the post), however, caused him many problems in L16 and L17, both with the two consonants at the beginning and in the middle of the word.

Two consonants in the middle or at the end of a word seem to be even more difficult for Marc to handle. In lesson two he was writing names of family members, and the name "Hans" caused difficulties (L2.1.23-26). He wrote Has, listened to auditory feed-back, and then tried a <g>: Hasg. He ordered auditory feed-back twice, then erased <g> and, on a hint from the teacher, inserted <n>. In lesson three, when he again wrote names of family members, he did not write "Hans" but Hasse, a nick name for "Hans" (L3.1.10-11, 20-24).

He was going to write "väska" (bag) (L7.1.24-26), and he wrote: VÅSA. When he heard the speech synthesis pronounce "väsa" (hiss), he said "no", independently ordered feed-back, erased <A> and suggested <K> for the next letter. He managed to write VÅSKA (bag). A problem of the same kind was "sökte" (looked for) (L13.1.9-19). Marc wrote söke, listened to it and erased the three last letters. Then he wrote skt, and asked "why does it say only s,k,t?" After the teacher had tried to explain that there must be another letter also, so the word can be read out, but without mentioning the concept "vowel", Marc wrote söke again. He ordered feed-back, erased <e>, and then wrote sökte.

The word "först" (first) with three consonants caused him more problems still (L12.1.1-8). He tried with föt, fg, ft, för, fört, until he, with some help from the teacher, managed to write först. He ordered auditory feed-back every time when he wrote a letter and had a new version of the word.

Marc wrote about a football game where he scored a goal when the goal-keeper stood at one post and he hit the ball near the other post (L16, L17.1.9-12) He wrote såpen as the first version of the word "stolpen" (the post). Before the next lesson, the teacher erased most of "såpen", and left only a <s>, she was apparently afraid that Marc should learn to spell the word in the wrong way. He sounded out the word in cooperation with the teacher and wrote stol. Then he had difficulties in finding the next sound, /p/, although he earlier used <p> in his first attempt, såpen.

In the next lesson he wrote about the incident when he hit the ball to the other post, and now he wrote såpen again for "stolpen", the post (L18.1.5-14). Marc and the teacher sounded out "st" together, and Marc wrote sto. After that Marc sounded out a <p>, and the result was: stop. He reacted with astonishment when speech synthesis read out "stop". In cooperation with the teacher he sounded out

the l-sound and inserted <l> in its right place in “stolpen”. The word had a consonant cluster both in the beginning and in the middle, and Marc needed both the auditory feed-back and the help of the teacher to be able to spell it.

In this chapter there are three examples where Marc made a first attempt with some letters missing: sol for stol (chair), sat for skatt (treasure) and såpen for stolpen (the post). When he made a new attempt after erasing letters, he had difficulties in finding <o>, <a> and <p> again, even if he had written them in his first version of the words. The field notes especially mention this difficulty (L17.1.13-20) and explain it with the experience of a failure.

Marc occasionally wrote words with double consonant. “Anne” and “Hasse”, names of family members, were among them. Every time when he was writing “Anne” (L2.1.20, L3.1.8,16), the teacher remarked: “two n”, and when he wrote “Hasse” (L3.1.21-23), she said: “two s”. When he tried to write “skatt” (treasure) (L13.1.25-27), he had much trouble because he wrote “skat”, with only one <t>. There is nothing in the field notes about how he succeeded in writing “skatt” with double consonant, so probably the teacher simply told him to write another <t>.

In the videotaped lesson fifteen Marc was writing “mitt” (my) (CD1MarcL15Epi11). He sounded out /m/, /i/, and /t/ and found the letters on the keyboard. When he had written mit, the teacher said: “and another t”. Marc did not obey the teacher immediately, but he ordered feed-back and listened to “mi:t”. After that he took another <t> and listened to feed-back on the correctly spelled mitt (my). When Marc was writing fotboll (football), (CD1MarcL15Epi12), after some difficulties he had managed to write fotbol, almost the whole word, but with only one <l>. The teacher said: “even two l”, and Marc took another <l> and after that listened to feed-back. The teacher instructed him to write double consonant.

There are two examples when Marc had the opportunity to independently explore the function of double consonant with the help of auditory feed-back. He wrote about the football game where he scored one goal (L16.1.29-31), and he wrote two words without space: etmå (onegoal), where “ett” (one) should have been written with two <t>. When he inserted a blank space, speech synthesis pronounced “e:t” and not “ett” (one) which was the intended word. Now there were possibilities for Marc to explore how to spell “ett” (one) to get the word pronounced in the correct way by the speech synthesis, and there were also possibilities for discussions about it between Marc and the teacher. When Marc wrote the name of his football team, Bkfk City, he wrote citt, with double consonant. When he heard auditory feed-back on “citt”, he laughed and erased the second <t> (CD1Mrcl15epi10).

7.3.5 Summarising reflections

In the ten first lessons, Marc could not read words, although he knew all the letters in a word and could pronounce the sounds of the letters. To know the letters and their sounds was not enough for reading a word. After about three more months of schooling and, also, much practice with words in the lessons with speech synthesis, he managed to read and write short words.

The assessment report (Appendix 4) shows development in phonological awareness and in reading and writing from pre-test to post-test. At the first testing, Marc did not get any points at all in the segmentation and synthesis task, and he could not read words although he knew many letters. At the second testing he had three correct responses in segmentation and four correct responses in synthesis, and he read short sentences.

To distinguish a word as a unit of meaning in the continuous stream of speech sounds is certainly a demanding task for the learner. Marc had already in the first lessons some comprehension of the function of the space bar and of the space after a word. When he learned to use a space after the words also in a sentence, he had a better understanding of the word as a unit of meaning.

The direction of written language was not yet quite clear for Marc. He sometimes started to write from the end of a word, from the right, and in the first lessons he also tried to start reading from the right. The teacher prevented him from starting from the right by pronouncing the words in the beginning of the word very clearly. The scaffolding function was modelling and direction maintenance. When Marc sounded out and analysed words, two divergent tendencies were noticed. He sometimes suggested the vowel first, although the vowel had an intermediate position. Sometimes he wrote the first and the last consonant in a word or a syllable with no vowel at all. Words with combinations of consonants were difficult for Marc to write, and words with double consonant were even a greater challenge.

The teacher almost always told Marc when double consonant was necessary. The teacher used instruction as a means of assistance in these cases. Marc very seldom had the opportunity to try writing a word with double consonant, to listen to speech synthesis and to make a judgment of the result. Apparently, the teacher did not want to leave him alone struggling with too difficult words, because double consonant is deemed to be the most difficult trait in Swedish spelling (Wengelin, 2013b). On the other hand, there would have been opportunities to let Michael explore the spelling of words, for example the name Hasse, where the teacher told him to write another <s>, and she did not let him write and listen to “Hase”, which speech synthesis would have pronounced in a different way than the intended name “Hasse”.

There are some examples when Marc mentioned a vowel too early, and later had problems with finding it again in its right place. He suggested /o/ for the first sound in “boll” (ball) and he wrote sat for “skatt” (treasure). Later, when he had found /b/, the real first sound in “boll”, he had problems with finding /o/ again. When he had sounded out /sk/ for the beginning of the word “skatt”, he wrote skt, without the vowel <a>. He had already suggested the right vowel, only a little too early, and a minute or two later he could not find the vowel again, which seems a little puzzling.

7.4 Development of Literacy Skills – Writing a Story

Marc started his writing with auditory feed-back on the computer with random letters, then names of family members and then names of things in the classroom. The first time when he wrote whole sentences was in lesson eleven. He had talked about a skiing tour, and he accepted a suggestion from the teacher to write about it. He wrote two short statements. The teacher helped with the full stops.

vi var och skidade till öjbärget. sen for vi hem. *we were on a skiing tour to öjbärget. then we went home*
(L11)

Next story was about a birthday party. He wrote the story during three lessons, from lesson twelve to fourteen. The sentences were short, and the story described actions and episodes in temporal order. The second sentence was an explanation of the event. The teacher helped with full stops and upper-case letters.

Först for vi till Jacks kalas. Och han är 8 år. Vi sökte en skatt. Där fanns godis. Och presenten var en bygg sats. Sen for vi hem. *First, we went to Jack's party. And he is 8 years. We looked for a treasure. There were sweets. And the present was a construction kit. Then we went home.*
(L14)

In lesson fifteen, which was videotaped, Marc began to write a story about a football match. He started on his story before the football match was held, and he decided in cooperation with the teacher that he should write the result later (CD1MarcL15Epi5). He started with mentioning the football match, and after that, on the suggestion from the teacher, he wrote the name of his team. It was also on the suggestion from the teacher that he placed the presentation of the name of the team in the beginning of his story (CD1MarcL15Epi10). He went on writing the story during the last three lessons, and then he told about the result of the match and how he had scored a goal. He wrote two long sentences. The last sentence had a rather complicated structure, it consisted of two main clauses and a subordinate clause.

Bkfk city är mitt fotbollslag. Vi hade match mot smedsby. Vi förlorade mot smedsby och jag jorde ett mål. Jag jorde ett mål så att målvakten stod i stolpen och jag sköt i anra såpen *Bkfk city is my football team. We had a match against smedsby. We lost the game against smedsby and I scored a goal. I scored a goal so that the goalkeeper stood at the post and I shot to the other post*
(L17)

Marc did not independently use capital letters for the first letter in a sentence. When he started to write the story, the teacher reminded him that the initial letter should be a capital letter (CD1MarcL15Epi7). When he wrote the name of his team, the teacher also suggested capital letter (CD1MarcL15Epi10). After lesson 17, the teacher alone (L17.1.34) made a capital letter in the name Smedsby, and she also corrected some misspelled words.

Marc also needed the cooperation with the teacher for the use of full stop. The teacher told him to make a full stop after he had written “vi hade match mot smedsby” (we had a match against smedsby) (CD1MarcL15Epi9). However, Marc seemed to be aware to some degree of the function of full stops. When he was going to write the name of his team, and he was going to write that immediately after his sentence about the match against Team Smedsby, he suggested that he could erase the full stop (CD1MarcL15Epi10). On the other hand, he suggested a full stop between the two words in the name of his football team, Bkfk City (CD1MarcL15Epi12). He seemed to have some idea about the use of full stop, but his understanding was not very clear.

Marc made considerable progress in writing stories from his isolated words in the first lessons, to his two short sentences in lesson eleven and to his comparatively long and complicated story in the last lessons.

7.4.1 Summarising reflections

Before Marc started to write a whole sentence and a story, he had told the teacher about a recent pleasant activity. The teacher suggested that he should write a story about what he had told, and then he already had the ideas for writing from the conversation with the teacher. Text generation (Berninger & Winn, 2006), from ideas to language, had happened in spoken language, and text transcription happened with auditory feed-back from speech synthesis and in cooperation with the teacher.

All three texts are narratives in temporal order, which is a frequent type of written composition in the early school years (Alamargot & Fayol, 2009) The third text is made in a special way. Marc wrote the beginning of the story about his football team and about a coming football match. He wrote the rest of the story after the match. He was eager to tell about the match (L16.6), and, during three following lessons, he wrote about the result of the match and his own contribution to it, and he did not seem to be bored.

The first two texts are simple narratives, accounts of events in temporal order. The third text has traits of narrative superstructure (Alamargot & Fayol, 2009), with the presentation of the football teams in the beginning, and the goal he made as the novel element in the story. Marc did not make the structure of the story quite independently, but to a great deal in cooperation with the teacher.

7.5 The Use of Auditory Feedback

During the first lessons, Marc got acquainted with the F-keys, and how to use them to order feed-back from speech synthesis. The program responds automatically with the sound of the letter when a key is pressed, with the pronunciation of the word when the space bar is pressed, and with the whole sentence when full stop, question mark or exclamation mark is used. If the writer wants to hear feed-back repeated or wants to listen to feed-back in the middle of a word, he or she can order feed-back with an F-key. Already in the first lesson (L1.1.3-4) the teacher showed Marc how to use the F6 to make speech synthesis read out everything that he had written, and he used it a couple of times. In the second lesson the teacher showed him how to use F1 (L2.1.15) to read out a word or a combination of letters that he was writing. When he was writing the long name Antonia (L3.1.26-30) he listened many times with F1, mostly after a hint from the teacher.

The first example of independent use of F1 was in L6, when he was writing “mandel” (almond). When he had written the first part of the word, “MAN”, the teacher told him to order feed-back with F1. After that, he ordered feed-back without any hint from the teacher, once more on “MAN”, then when he had written “MAND”, and at last when he had written the whole word, MANDEL (CD4MarcL6Epi4). He went on independently ordering feed-back with F1 when he wrote more words during the lesson. When he was writing the word “väska” (bag) (L7.1.12-26), (chapter 7.3.3), and he at first had written VÅSA (hiss), which was another word, he ordered feed-back and started to correct the word without any hint from the teacher. He noticed rapidly that there was a mistake and corrected it.

In lessons eight and nine he wrote many isolated words, and he used F1 to order feed-back for almost every letter he wrote. For example, he wrote DATA (L9.1.30), and for every letter he ordered feed-back with F1 and could follow how the word was shaped. In the field notes from the same lesson (L9.1.35) there is a comment that “Marc is very systematic and analyses the words.”

In the videotaped lesson fifteen where Marc had big problems writing the word “hade” (had), he ordered auditory feed-back as soon as he had written a letter (CD1MarcL15Epi7). He did that on his own, and the teacher needed not to remind him. When he wrote “match” (CD1MarcEpi8), and “fotboll” (football) (CD1MarcL15 Epi12), he wrote the three and four first letters and then ordered feed-back.

He also used auditory feed-back to create new words. When he was writing the word “korg” (basket) and had written two and three letters at the beginning of the word, he heard speech synthesis pronounce KO (cow) and KOR (cows), and then he wanted to write these words after he had finished KORG (chapter 7.1.2). He could make use of auditory feed-back to spell phonetic words right. When he wrote “city” (Cd1MarcL15Epi10), the teacher had informed him that the first letter was <c>, and then he wrote citt. When he heard feed-back on “citt”, he

laughed and erased the second t-letter. When he was writing “mot” (against) and had written mo, he ordered feed-back, and then he said that <t> ought to be there too. He added <t>, and the word “mot” was completed (CD1MarcL15Epi8).

Sometimes Marc was not sure if speech synthesis pronounced the intended sound or not, and in these cases the teacher helped him. When he was going to write “mot” (against), he had started with <m> and heard speech synthesis pronounce /m/. Then he said no, no, and he erased the letter <m>. The teacher reminded him that he was going to write “mot Smedsby”, (against team Smedsby), Then he started to write the word “mot” again, this time successfully (CD1MarcL15Epi8).

7.5.1 Summarising reflections

From lesson six forward, Marc deliberately used auditory feed-back from synthetic speech as a tool for his spelling and writing. He ordered auditory feed-back independently, and he did not need to wait for the teacher to remind him. He sometimes used auditory feedback to create new words.

Marc could use auditory feed-back to find the right letter and to check the words he was writing. If the word was not quite phonetically spelled, like the name Smedsby, /smessbyh/ and the word city, or if the word contained the letters <o>, <å> and <e>, <ä> where pronunciation can vary, auditory feed-back from synthetic speech did not lead Marc to the correct spelling of the word. In these cases, the teacher was more active and helped to find the right letter. The letters <m> and <n> pronounced by synthetic speech seemed to be a little difficult to distinguish from each other.

Marc could also by himself compare feed-back on his writings with the intended word and reacted to that, like in the examples above with “citt” for “city”, “mo” for “mot” and “väsa” (hiss) for “väska” (bag). If Marc wanted to write more difficult and non-phonetical words, the teacher helped him.

7.6 Scaffolding Writing

Three types of teacher’s actions are frequent during the lessons with Marc: instructing, modelling of sounding out speech sounds in words and questioning. Instruction is one of Tharp and Gallimore’s (1988) means of assisting performance. The teacher instructed Marc on technical matters, for example how to use F-keys, to order auditory feed-back (L2.1.15) and how to move the cursor to the right place (CD4MarcL4epi6). The teacher also instructed Marc to use the space bar after he had finished a word (CD4MarcL4epi7), to begin a name and a sentence with an upper-case letter, and to use a full stop to finish a sentence. (CD4MarcL4epi7). There are also examples where the teacher gave instructions on spelling, especially regarding double consonant, even if it could have been possible for Marc to find out the spelling using auditory feed-back from speech synthesis. When Marc was writing the name Hasse, the teacher told

him to take two s-letters (L3.23). When he was writing the words pappa (dad) and mamma (mum), the teacher also instructed him to make double consonant (CD4MarcL6epi5,6).

The teacher often modelled speech sounds. When Marc was going to write a word, except his own name, or another name which he already knew how to write, the teacher pronounced the word slowly and exaggerated the speech sounds. The teacher gave a model for finding the speech sounds which corresponded to the letter sounds, and Marc often joined the “sounding out”. When he wrote the name Antonia (L2.28-35), he knew the beginning, the first two letters, and after that he sounded out /t/ and searched for <T> on the keyboard in cooperation with the teacher (L2.29). Next lesson he wrote the name Antonia again, and now he could write the first four letters by himself, using auditory feed-back. Then he did not notice /n/, and he wrote ANTOI. He imitated speech synthesis when it said “Antoi”, and the teacher and he pronounced Antonia together to find the missing sound. At last, when the teacher sounded out /n/ in an exaggerated way, “Anto:nnnia”, Marc observed the sound /n/, erased <l> and completed the name with the missing letters (L3.25-31). The teacher modelled “sounding out”, an analysis of the speech sounds in a word, which gives the spelling of many words in Swedish. Modelling is both one of Wood et al.’s (1976) scaffolding functions and one of Tharp and Gallimore’s (1988) means of assisting performance.

In lesson eight there are many examples where Marc did the sounding out by himself. He was writing words, and in the word “spel” (game), he found all the letter sounds independently (L8.21-26). In some other words in lesson eight he also found letter sounds by himself. The teacher withdrew, and only when Marc had problems, for example when he wanted to begin the word “boll” (ball) with the vowel <o>, the teacher modelled the sounding out and exaggerated the first sound (L8.13-18).

Questioning is another of Tharp and Gallimore’s (1988) means of assisting performance, and questioning can have various functions. Some of the instructions in the first lessons appeared later as questions. There is a question about what key to use for listening to auditory feed-back (CD4MarL4epi6) and a question about the use of space: -When you have finished a word, what are you going to do then? (L8.2.17).

Other questions have the function of keeping Marc on the right track. Marc was writing the name of a dog, Jolli, in lesson six. When he had written l, he suggested <i> as the next letter. The teacher asked him then what the name of the dog was, although they already had said the name several times. Marc pronounced the name Jolli again, and the teacher also pronounced it and exaggerated /l/. Marc found /l/ and went on writing the word. In this case, the question had the function of direction maintenance, one of the scaffolding functions found by Wood et al. (1976).

There are also many questions about the first sound in a word. Especially when Marc starts to sound out from the end of the word or suggests an intermediate vowel, the teacher makes a question about the first sound. Chapter

7.3.2 describes how he wrote the words “lampa” and “ball”, started with the vowel, and the teacher interrupted him with a question about the first sound in the word. This type of questions also has the function of keeping the writer on the right track, or direction maintenance.

Another group of questions is of the type “What do you want to write today?” These questions had the function to inspire writing, like the function “recruitment to task” which Wood et al. (1976, p98) mention.

7.6.1 Example

In the following example from the videotaped lesson fifteen, instruction, modelling through sounding out and questioning occur. Marc writes about his football team and he is going to write “vi hade match mot Smedsby” (we had a match against Smedsby). He is working on the word “hade” (had). The teacher is more passive in this example and allows Marc to try more independently than in many other examples. This example is from one of the last lessons, and it is also an example of withdrawing, one of the core characteristics (van de Pol et al 2010) of scaffolding.

	<i>CD1MarcL15Epi7</i>	
	<i>B: sku du ha 'va' eller 'hadde'?</i>	<i>B: would you take 'was' or 'had'?</i>
	<i>M: hadde</i>	<i>M: hadde (had)</i>
	<i>B: hmm. ((nickar)) då tar vi hadde.</i>	<i>B: hmm ((nodding)) let's take 'had'</i>
	<i>B: va börjar hadde me?</i>	<i>B: what does 'had' begin with?</i>
	<i>M: hadde</i>	<i>M: hadde (had)</i>
	<i>B: hadde</i>	<i>B: hadde (had)</i>
	<i>M: hadde, d, de</i>	<i>M: hadde (had), d, de</i>
	<i>B: pröva</i>	<i>B: try</i>
<i>d</i>	<i>((M tar <u>d</u>, tar F1, Ove säger bokstavsnamnet 'd'))</i>	<i>((M takes <u>d</u>, takes F1, Ove says the name of the letter 'd'))</i>
	---	---
<i>de</i>	<i>((M tar <u>e</u>, resultat: <u>de</u>))</i>	<i>((M takes <u>e</u>, result: <u>de</u>))</i>
	<i>M: v affö...</i>	<i>M: why...</i>

Marc started to write from the end of the word, not from the beginning, and wrote de (they) instead of “hade” (had). The teacher did not prevent him, but she said only: “pröva” (try). When speech synthesis pronounced de, Marc said: Vaffö...(Why). After a long discussion with the teacher, he erased de and started to look for the first letter in the word again.

	<i>B: jo men va börjar de me?</i>	<i>B: yes but what does it begin with?</i>
	<i>M: a</i>	<i>M: a</i>
	<i>B: hadde</i>	<i>B: hadde (had)</i>
	<i>M: h</i>	<i>M: h</i>
	<i>B: ((viskar)) jo</i>	<i>B: ((whispering)) yes</i>
<i>h</i>	<i>((M tar <u>h</u>, Ove uttalar h))</i>	<i>((M takes <u>h</u>, Ove pronounces h))</i>

<p>----</p> <p>B: hadde M: hadde B: ja, ((nickar)) M: d</p> <p>hd ((M tar <u>d</u>, resultat: <u>hd</u>)) ((M tar F1, Ove uttalar bokstavsnamnen 'h,d')) ((M takes F1, Ove pronounces the names of the letters 'h,d'))</p> <p>hde ((M tar <u>e</u>, Ove uttalar e)) ((M tar F1, Ove läser ut 'hde' som bokstavsnamn)) ((M takes F1, Ove reads 'hde' with the names of the letters)) M: nä de ska int vara B: jo de ska no va 'e', men de e nånting borta där i början. B: yes it's supposed to be 'e', but something is left out there in the beginning</p>	<p>---</p> <p>B: hadde (<u>had</u>) M: hadde (<u>had</u>) B: yes ((nodding)) M: d</p> <p>((M takes <u>d</u>, result: <u>hd</u>))</p> <p>((M takes <u>e</u>, Ove pronounces e))</p> <p>M: no it's not supposed to be</p>
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Marc left out the second letter, the vowel <a>, and the teacher did not prevent him. He left out <a>, although he recently had suggested it for the first letter in the word. The result was a string of consonants: hde. Now the teacher gives an instruction, and soon after that she makes a question about what he is writing.

<p>B: om du tar bort dendär 'd' nu, så ska de va en annan före. B: de kommer nog "d, e" sen. ((M raderar d e))</p> <p>h M: h B: jo ((nickar)) M: e B: va va e du sku skriva? to write?</p> <p>M: hadde B: jo M: [hadde B: [hadde M: ha...a B: jo ((nickar))</p> <p>ha ((M tar a, resultat: <u>ha</u>)) ((M tar F1, Ove läser ut "ha")) M: d, då kommer de B: ja de gör de</p> <p>had ((M tar d, resultat: <u>had</u>)) ((M tar F1, Ove läser ut "had")) M: e B: ja ((M tar e, resultat: <u>hade</u>)) hade</p>	<p>B: if you remove that 'd' now there will be another one before B: "d, e" will surely come later ((M erases d e))</p> <p>M: h B: yes ((nodding)) M: e B: what were you going</p> <p>M: hadde (<u>had</u>) B: yes M: [hadde (<u>had</u>) B: [hadde (<u>had</u>)</p> <p>M: ha...a B: yes ((nodding)) ((M takes a, result: <u>ha</u>)) ((M takes F1, Ove reads out "ha")) M: d, then de (letter name) will come B: yes it will ((M takes d, the result is <u>had</u>)) ((M takes F1, Ove reads "had")) M: e B: yes ((M takes e, result: <u>hade</u>))</p>
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*((M tar F1, Ove läser ut "hadde",
med talspråksanpassning))*

*((M takes F1, Ove reads "hadde" (had),
adapted to colloquial language))*

A question which occurs several times is "what are you writing?" The function of the question seems to be to keep Marc on track in his writing. The second type of question is about the first sound and sometimes about the last sound in a word.

7.6.2 The right amount of scaffolding

A core characteristic of scaffolding is adjustment to the learner and to the task, which means that finding the right amount of scaffolding is a constant challenge. Sometimes the teacher helped too much, for instance in the example where the teacher instructed Marc on double consonant in "pappa" (dad) and "mamma" (mum) so Marc lost the opportunity to try out and discover the correct spelling by himself. On other occasions, the teacher gave instructions which were necessary to remove a problem that Marc not yet was able to solve. For example, when Marc was writing the name of his football team, Bkfk City, the teacher simply told him that "city" begins with <c>.

In the example above with the word "hade" (had), there are some examples where the teacher could have helped more. When Marc started from the end of the word, and suggested <d> and "de", the teacher could have explained about the beginning and the end of the word "hade". Also, when Marc left out the vowel and wrote "hde", the teacher could have helped. Marc had to struggle with the word for a long time, three and a half minutes, before it was finished. He could have used the time to write more about his football team instead. Fading or withdrawing is one of the core traits in scaffolding (Van de Pol et al., 2010), but in this example, fading obviously happened too early.

More appropriate examples of withdrawing occurred in lesson eight, when Marc did the sounding out by himself and wrote words independently (L8.21-26), and the teacher modelled sounds only when Marc had a problem. The teacher withdrew from modelling and transferred responsibility to Marc, when he had the capacity to manage.

7.6.3 Repair as a type of scaffolding

Repair is a type of scaffolding which is used when there is a misunderstanding, a problem in the communication or when the speaker is not satisfied with his utterance (Martin 2004). The repair organization consists of the trouble source, the initiation of repair and the repair itself. Repair occurs both in writing and in conversation between Marc and the teacher.

A sequence of repair is found in the example in 7.6.1. Marc was going to write the word "hade", but he started from the end and wrote de. When he ordered feed-

back with F1, speech synthesis read out “de” instead of “hade”, and Marc reacted with “why?” Marc noticed the problem by himself. After a long discussion with the teacher he erased de. Repair organization is self-initiated assisted self-repair.

The next step in Marc’s work with the word began with the teacher’s question about the first letter in “hade”. Marc’s answer was “a”, and the teacher repeated: “hade”. Then Marc made a new answer: “h”, and the teacher confirmed it with “yes”. The problem source here was finding the initial letter. The teacher signalled that his suggestion was not correct by repeating the word, and now Marc found the initial letter. Repair organization is other-initiated self-repair.

Marc went on writing the word “hade”, and he wrote hde, without the vowel <a>. He ordered feed-back, and speech synthesis read out the letter names: h-d-e. When Marc heard feed-back, he said “no, it’s not supposed to be”. The teacher explained to him that the letters were the right ones, but he had left out a letter, and she instructed him to erase the letters <e> and <d>, and he did so. Repair organization was self-initiated other-repair.

He suggested <e> for the next letter after <h>, and the teacher modelled the word “hade” and made him repeat it several times. At last he found out that the following letter was supposed to be <a>. Repair organization is other-initiated assisted self-repair. Marc managed to finish the word “hade” with <d> and <e> and with no need for further repair. His work with “hade” contains a sequence of repair.

Other examples of repair are also found in lesson 15. When Marc was writing the name of his team, Bkfk City, he wrote citt (CD1MarcL15Epi10). When he heard feed-back on “citt”, he laughed and erased the second <t> on his own initiative. Repair organization was self-initiation and self-repair.

Marc wrote the word “fotboll” (football) (CD1MarcL15Epi12). He managed to write the beginning of the word, but when he came to the end of it, he wrote fotbob. He noticed that there was a problem and asked the teacher if speech synthesis said “fotboll” or something else. The teacher advised him to look at the word on the screen. Marc read his word and said: - No be (inget be). With a little help from the teacher he erased . Repair organisation was self-initiation and assisted self-repair.

The examples of repair organization in lesson fifteen can be compared to examples in lesson six, which also was videotaped. The word “mandel” (almond) was one of the first words which Marc himself suggested for writing (CD4MarcL6Epi4). When he had written M, he pronounced the word, exaggerated the last sounds and suggested /ell/ for the next letter. The teacher answered that there are some other sounds before /ell/ and modelled the beginning of the word: /ma/. Marc pronounced /a/ and then pressed the A-key. Repair organization was other-initiation and assisted self-repair.

When Marc had written MA, he searched for the rest of the word and suggested /e/. The teacher said again that there is another letter before that and modelled /n/, and Marc repeated /n/ and pressed the N-key. When he had

written MAN, he again suggested /ell/, and the teacher explained that there are other sounds before /ell/ and modelled /d/. Michael repeated /d/, he looked for it a long time and eventually found it. Repair organization was the same as in the case of <A>, other-initiation and assisted self-repair.

When Marc had written MAND, he again suggested /ell/, and the teacher answered: - Almost. This time Marc immediately suggested /e/ and wrote it, and repair organization was other-initiated self-repair.

Marc wrote PAPPA (dad) in lesson six, and repair occurred twice during his writing (CD4MarcL6Epi5). When he started to write the word pappa, he suggested /a/ for the first sound and pointed to <A> on the keyboard. The teacher responded with “no”, and Marc pronounced “papa” several times, sounded out /p/ and began to look for <P> on the keyboard. He pointed to <D> and to <P>, the teacher supported <P>, and he chose <P>. Repair organization was other-initiation and assisted self-repair.

After that he took <A>, listened to feedback on PA, repeated /pa/ and said /pappa:/. Then he suggested another /a/. He looked at the teacher who did not respond. Marc said “no”, pronounced /papa:/ and /p/ again and began to search for <P> on the keyboard. He pointed to <D> and to <P> again, and he did not take <P> until the teacher had asserted that it was correct. Repair was self-initiated assisted self-repair. Table 5 shows the repair organisation in the examples above.

Table 6. *Repair organisation, Case 2*

Word, Sequence	Repair organisation	Lesson
Mandel (ml – ma)	Other-initiated assisted self-repair	L 6
(almond) (mae – man)	Other-initiated assisted self-repair	
(manl – mand)	Other-initiated assisted self-repair	
(mandl – mande)	Other-initiated self-repair	
Pappa (a – p)	Other-initiated assisted self-repair	L6
(dad) (paa - pap)	Self-initiated assisted self-repair	
Mamma (maa -mam)	Other-initiated self-repair	L6
(mom)		
Hade (de - -)	Self-initiated assisted self-repair	L 15
(had) (a – h)	Other-initiated self-repair	
(hde – h)	Self-initiated other-repair	
(he – ha)	Other-initiated assisted self-repair	
City (citt – cit)	Self-initiated self-repair	L 15
Fotboll (fotbob - fotboll)	Self-initiated assisted self-repair	L 15
(football)		

A tendency of more independence can be noticed in the examples of repair. More examples of self-initiation occur in lesson fifteen than in lesson six. A tendency of--- independence can also be noticed in the sequences in the work with the words “mandel” and “pappa”, but not with the word “hade”.

7.6.4 Summarising reflections

Modelling was a frequent scaffolding function in the lessons with Marc. The teacher often in an exaggerated way pronounced the speech sound which Marc was searching for, which corresponds to the description of modelling as involving an “idealisation” of the act to be performed (Wood et al., 1976). Modelling is both one of the scaffolding functions that Wood et al. (1976) described and one of the means of assisting performance that Tharp and Gallimore (1988) described.

Instruction was a frequent means of assisting performance, and instructions concerned both technical matters and spelling of words. Some of the instructions reappeared later as questions, and questioning had various functions. Questioning was often used when Marc had problems in writing, for example when he started spelling from the end of the word and when he suggested an intermediate vowel for the first sound. In that case the questions had the function of direction maintenance (Wood et al., 1976), i.e. keeping the writer on the right track.

Finding the right amount of scaffolding was a challenge for the teacher. Examples occur, when the teacher instructed too much, as well as examples when the teacher gave too little help.

Repair organisation could be studied especially in the videotaped lessons. Studying repair organisation means studying the structure of this type of scaffolding, whereas scaffolding functions, means and intentions are more a description of the content of scaffolding.

Self-initiation was more frequent in the late lesson fifteen than in the early lesson six, which can indicate increasing self-regulation.

All other types of repair organisation were found than other-initiated other-repair. The teacher sometimes made corrections in Marc’s text after he had left, for example in lesson seventeen when she changed the first letter to a capital letter in the name *Smedsby*, and she also corrected some misspelled words (L17.1.34). The teacher’s corrections of Marc’s spelling when he was not present could be examples of other-initiated other-repair, if they are analysed according to repair organisation.

7.7 Summary of Case 2

Mark knew many letters already in the first lessons, but he did not manage to read words, even if he knew all the letters in the word. His ability to segment words and to make synthesis of speech sounds was at a low level when the project began (Appendix 4), which could explain his difficulties with word reading. When he had difficulties in spelling a word, the teacher sounded out the word in an exaggerated way, i.e. she used the scaffolding function of modelling.

In lesson twelve he began to read words, and at about the same time he also began to write sentences and not only single words. Before he wrote a sentence, he had told the teacher something he had done, which means that he made text generation (Berninger & Winn, 2006) during or after his oral presentation of the theme.

Sometimes, Marc started reading or writing a word from the right, from the end of the word. On those occasions, the teacher often asked him about the first letter in the word, which means that she used questioning as a means of scaffolding. He began sometimes writing a word with the first vowel and not with the first sound, and sometimes he wrote words with no consonant at all. If he had suggested a letter too early, he did not easily suggest that letter again in its correct place later in the word. Words with combinations of consonants were challenging for him. When he wrote words where double consonant was required, the teacher almost always instructed him to write two consonants.

Marc rapidly learned to use F-keys independently to order auditory feedback on letters, words and text. He also used feedback to make new words, especially in the first lessons when he did not write texts and did not manage to read words.

Instruction and questioning were two means of assisting performance which the teacher often used. Instructions were reformulated as questions in later lessons, and some questions had a scaffolding function of direction maintenance. Modelling was a frequent type of scaffolding function, especially in early lessons.

Repair occurred both in utterances when Marc was sounding out words and in writing, when he tried to find the correct spelling of a word. Self-initiation occurred more often in the late lesson fifteen than in the early lesson six.

8 Writing Non-fiction Stories and Learning Double Consonant and Punctuation. Case 3

The principal character in case three is Chris, nine years old and in the third grade. He wrote texts with auditory feed-back from speech synthesis once or twice a week from September to February, in a one-to-one situation with a teacher. Some training programs with feed-back from synthetic speech were also used to give variation in the job with text-writing.

Chris read rapidly, relatively fluently with good reading comprehension when the project started. He had some problems with spelling, especially with double consonants, with the use of the letters <o> and <å> and with words which are not phonetically spelt (appendix 6).

Twenty-six lessons were given, and the average length of a lesson was 23 minutes. There are two videotapes, one from lesson thirteen, 19 minutes and 20 seconds, and the other from lesson twenty-six, 20 minutes and 33 seconds.

In this text, Chris' own writings are marked with underlining. References to fieldnotes are written with lesson, page and line number, for example (L.1.37-39), and references to videotapes are written with CD number, name, lesson number and episode number, for example (CD4ChrisL13epi1)

Chapters 8.1, 8.2, 8.3, 8.4 and 8.5 deal with the first research question about development of literacy skills. Chapter 8.6 deals with the research question about use of auditory feed-back, and chapter 8.7 deals with the research question about how the teacher scaffolds writing.

8.1 Development of Literacy Skills - To Find the Urge to Write

Chris was introduced to writing with feedback from speech synthesis together with his classmate John, who is the principal character in case 4. Both the boys seemed to be eager to start writing on the computer and to listen to how speech synthesis pronounced the words. Chris talked about their computer at home and typed his name and other words quickly. Sometimes he wrote so fast that the teacher did not manage to see what he did. (L1.1.37-38.)

He wrote a string of letters, igbjn, and laughed when the letters were pronounced by speech synthesis (L1.1.30-31). Then he wrote a swearword, FAN (damn), and he was delighted (L1.2.19-20) when speech synthesis pronounced it. Apparently, Chris found speech synthesis rather amusing, and he had no difficulties with typing.

At the end of the lesson, Chris and John played a hangman-game, also an Ove-program. In the following lessons, Chris wrote a word in the game for John to guess when he had his lesson, and John on his lesson did the same thing. So

almost every lesson started with trying to find out what word the classmate had loaded into the hangman-game. The reason for using a hangman-game was to make it more interesting for the boys to come to the lessons, and to provide a possibility to spell words with auditory feed-back in a more playful way.

Chris came alone for the second lesson, and now the writing project really started. He wrote strings of numbers and letters, and he was amused when speech synthesis read the numerals as a number with millions and billions. He wrote some isolated words, and according to the field notes, he looked troubled (L2.2.1-14), and he said: "Vad skulle man kunna hitta på nu?" (What could I think of now?)

8.1.1 Finding something to write about

In lesson three the teacher told Chris that "we" are going to write a story. He sighed, but he started to write and wrote a sentence about a tree. He asked if the story had to be long, and then he went on writing about a woodman who cut down the tree. He used also the following lesson to finish the story.

Then Chris had to find a new theme to write about. The teacher asked him a couple of times what he wanted to write, and he answered that he had been thinking of that too. He wrote strings of letters and numbers again. He tried out the symbols on the keyboard, and he listened how speech synthesis pronounced them. The teacher suggested that he could tell how he used his computer at home, and he started to write about his computer games (L5.2.11).

The next lesson he went on writing about his computer games. He was busy doing that, and the teacher had to remind him of lunchtime. "Så snabbt?" (So soon?), he said when he had to interrupt his work (L6.2.27). During the four following lessons, he wrote about his computer games, until the story was finished (L11.1-5)

After that Chris did not find a new theme to write about, and he wrote strings of numbers, letters and symbols (L14.1,4-19). The teacher wrote a question to him about what he had done during the break, and then he sighed, but he wrote a short answer (L14.1.22). When he listened to the strings of letters and numbers he had written, he laughed a little (CD4ChrisL 13epi2), but, on the contrary, when he listened to the answers he had written to the teacher's questions, he did not laugh (CD4ChrisL13epi). The next lesson he again wrote strings of all kinds of symbols (L15.1.4-32), but finally he started to write about his pets (L15.1.36-43), and he went on writing about the pets during the four following lessons.

In lesson twenty he wrote with enthusiasm about New Year's Eve and fireworks. The teacher commented in field notes that he wrote eagerly (L20.1.44). After that he did not want to begin with a new story, so the program in the following lessons was training programs and questions and answers on the computer. The teacher remarked (L24.1.10) that Chris wrote only very short answers. Finally, Chris started to write about a trip to an amusement park, and he wrote independently and eagerly (L26.1.1-22) during the last lesson.

8.1.2 Playing with words and symbols

Chris investigated the keyboard and speech synthesis in a playful way. When he wrote strings of letters, he discovered the function of vowels (13.1.32-35): Only when a letter string contains a vowel, speech synthesis can read it out. If a letter string consists only of consonants, speech synthesis just says the names of the letters.

Chris also investigated how speech synthesis pronounced symbols, for example !, #, &, /, (and). When the teacher interrupted his investigation of symbols and asked him to write about what he had been doing in the schoolyard during the break, he wrote: jag lekte kissa med joni&janne&joni (I played tag with joni&janne&joni&). He explained that he noticed that ‘&’ is pronounced like ‘och’, and “then I need not write so much” (14.1.26-28). He also later wrote ‘&’ instead of ‘och’.

The Ove program can be adjusted so that speech synthesis reads the text faster or slower than a normal voice. In lesson thirteen the program was, probably by mistake, adjusted for fast speech. When the teacher was in another room, adjusting the video camera, Chris started to write nursery rhymes with fast speech. The rhymes are meant to be difficult to pronounce, tongue-twisters: “sex laxar i en lax-ask” (six salmons in a salmon-box) and “packa pappas kappsäck” (pack daddy’s suitcase). He wrote quickly a new version of the rhyme, this time with an exclamation mark: fem laxar i en ask! (five salmons in a box). He started to play with the marks, and he wrote eleven exclamation marks and listened when speech synthesis pronounced it. After that he still wrote a new version of the rhyme: En lax i en tensticks ask!! (a salmon in a matchbox), now with two exclamation marks. (CD4ChrisL13epi1-2, L13.1.16-30).

When Chris came to lesson seventeen, he said: I shall try something. Then he wrote words in this way:

BIL (car)
OST (cheese)
LÖK (onion)
LIDA (to suffer)

If the words are read vertically, the word “boll”, (ball), can be found in the first column. Chris tried to let synthetic speech read vertically, but, of course, that was not possible. He said that he had seen this kind of secret writing in a Tintin-book.

Chris investigated the keyboard and the speech synthesis and used symbols in a creative way. He played with language when he used the fast speech synthesis to say tongue-twisting rhymes and when he made a secret writing. He started his playful activities on his own initiative, and sometimes even when the teacher was in another room.

8.1.3 Summarising reflections

When Chris found an interesting theme to write about, he wrote rather long stories, sometimes for several lessons. When he had finished a story, it took some time until he found a new theme, and during the meantime he only wanted to try symbols on the keyboard or to do training programs. The themes which inspired him to make stories, were very close to him: his computer games, pets, fireworks and family trips. Chris was eager to write on the computer and he smiled and seemed amused when he listened to auditory feed-back, circumstances which probably made it easier for him to engage in writing.

The teacher had suggested the themes which inspired him to write: his computer games (L5.2.10-11), his pets (L15.35), New Year's Eve (L20.2) and the trip to the amusement park (L25.23). The teacher often asked what he would like to write about, but only once he responded with a story, in lesson three when he started to write about a tree and a woodman. The teacher's suggestions of story themes and her questions about what he wanted to write, had the function of recruitment to task, one of the scaffolding functions mentioned by Wood et al. (1976). On the contrary, when Chris asked for the continuation of a nursery rhyme which he wanted to write, and the teacher talked of full stop instead of answering his question, he lost his interest in writing the rest of the rhyme. Instead, he started to write letter strings and to investigate signs on the keyboard.

The use of hangman-games where Chris and his classmate made word riddles to each other helped the boys to keep up their interest for coming to the lessons and had the scaffolding function of frustration control (Wood et al., 1976).

Chris wrote strings of letters, numbers and symbols on his own initiative and investigated how speech synthesis pronounced them. He wrote nursery rhymes with speeded pronunciation when the teacher was not present. The teacher let him do his investigations for a while, but then usually tried to engage him to write words and texts in a more conventional way.

8.2 Development of Literacy Skills – Writing Words

Chris made spaces after the words on his own initiative already in the first lessons, which means that he had clear understanding of the word as an entity.

He managed to write most phonetic words, even words with consonant combinations, for example spindlar (spiders) (L7.1.33), and long words, for example akvariet (the aquarium) (L17.1.37). He also managed to write words which were not totally phonetic, like möjligt (possible) (L12.1.13) where <g> is not pronounced, and words with /ŋ/, like inga (no) (L12.1.29).

He had, quite naturally, difficulties with /ʃ/ and /j/, which can be spelt in various ways. He wrote skuta and skiuta until the teacher gave him a hint about "skjuta" (shoot) (L8.1.11-16), and he wrote jelpa for "hjälpa" (help). He also had problems with words which are written with <e> or <ä>, and when

pronunciation does not show if <e> or <ä> ought to be used, for example in jelpa for “hjälpa” above.

When Chris wrote words in which the choice between <o> and <å> was difficult, he often used auditory feed-back to find the correct spelling (8.6). The Assessment report (Appendix 6) mentions that he made even more mistakes in the post-test with confusion of <o> and <å>. The greater number of mistakes in the second testing can be interpreted as a period of overuse (Naucclér, 1985, 1989). He was possibly more aware of the problem in the second testing and tried various ways of spelling words with <o> and <å>.

8.3 Development of Literacy Skills - the Problem with Double Consonants

Chris sometimes wrote words with double consonants quite correctly already in the first lessons. He obviously had some understanding that double consonants must occasionally be used. But he had, like many other novice writers of texts in Swedish, many difficulties with writing words in which double consonant was required. He made spelling errors and wrote only one consonant where there should have been double consonants, for example flipper instead of “flipper”. Errors of this type occur a couple of times during most lessons, but the correctly spelt words with double consonant are more frequent than those which are spelt with a single consonant.

He also made spelling errors of the opposite type, double consonants where only one consonant was needed, for example killo for “kilo”. From lesson one to ten this type of spelling error was rare, it occurred only twice. From lesson thirteen to lesson twenty, however, these spelling errors occurred a couple of times in most lessons. Chris seemed to gradually become more aware of the problem with double consonants, and he tried it out with different spellings and sometimes made too much of it.

Table 7 is an overview of Chris’ writings of words with double consonant. The lessons in which he did not write any words with double consonant are omitted.

8.3.1 Single consonant instead of double consonant

In the following text, some examples will be mentioned where Chris wrote words with only one consonant when the norm is double consonant, and where he corrected his spelling and listened to speech synthesis.

Chris wrote about a tree which was chopped down by a woodman, in Swedish “skogshuggare” (3.1.39-3.2.7). He wrote the word with only one <g> in the second part of the word, skogshugare. He listened to the whole story with F6, and the teacher told him that he could listen to the last word with F1. He did that, and then he erased the last three letters and wrote ‘g,a,r,r’, so the result was skogshuggarr. He erased <r> and wrote <e>, and now the result was

skogshuggare, correctly spelled. He listened to the word with F1 and started to erase again. The teacher asked: - Wasn't that good?

However, Chris erased the last five letters and wrote: skogshugaree. He listened with F1, erased <e>, then listened with F1 again. Then he asked the teacher: How shall I write it? Two g's? The teacher probably nodded, and Chris wrote: skogshugare. The double <g> was in the wrong place. Then he erased most of the word and wrote: skogs-hugare. He erased the last three letters and wrote: skogs-huggare. - It is a bit better now, he declared.

Chris used speech synthesis actively, ordered auditory feed-back with F1 and changed his spellings. The synthetic pronunciation of compound words was not very good, which can explain why he was not satisfied with his first correct spelling of the word. The teacher's hint of two g-letters was misleading, but at last Chris managed to write the word correctly.

In lesson 26, the last lesson, Chris was writing about a rotating restaurant and he wrote the word "snurrade" (rotated) with only one <r>. The teacher reminded him to listen to auditory feed-back, and Chris noticed that something was wrong with the word and tried with two <n>, snnurade. He also tried other vowels, <y> and <o>, and he listened to feed-back and changed the vowel to <u> again. At last he exclaimed: -Two <r>! He inserted another <r> and ordered feed-back on the word snurrade, which now was correctly spelled (CD6ChrisL26epi6).

In Swedish the letter 'k' cannot be used as a double consonant, and 'kk' is written as 'ck', which can cause some difficulties for children learning to spell words. Chris wrote about a computer game where the task is to gather balls, 'plocka bollar' in Swedish. When he was writing the word 'plocka', gather (7.1.33-38), he pointed to the letters <o>' and <å>' on the keyboard, the teacher pointed to <o>', and he wrote ploka.

When he had written the whole sentence, he went back to the word 'ploka' and listened to it twice with F1, probably on a suggestion from the teacher. Then he changed the word to plloka. He listened to the word with F1 and changed it to plocka. After that he listened with F1 to his now correctly spelled word plocka.

With these words Chris could use feed-back from speech synthesis to spell in a correct way, with some help from the teacher. There are a few examples where speech synthesis did not help Chris to spell the words. When he wrote glöma (16.1.11) for 'glömma', forget, he did not react when synthetic speech pronounced 'glöma'. In the following lesson (17.1.34-38) he wrote glöma again and did not try to change it. The teacher afterwards changed the word, so it was spelled in a correct way when Chris went on writing on his text in lessons 18 and 19. There are special rules for <m> and <n> in Swedish, so a single <m> is sometimes pronounced in the same way as a double <m>.

Table 7. Overview of the use of double consonant, Case 3 * C did not correct the word

Lesson	Double consonant correct at once Correct form in slashes	Single consonant instead of double cons. Correct form in slashes	Double consonant instead of single cons. correct form in slashes
2.	hulla /hylla/ (shelf), batteri (battery)		
3.	ett (one), att (that),	skogshugare (woodman) /skogshuggare/	dett (it) /det/
4.	opp (up)	hög (chopped) /högg/ fans (there was) /fanns/	
6.		*fliper /flipper/	
7.	bollar (balls)	fliper, *skal (shall) /skall/ ploka (pick) /plocka/	
8.	gubbarna(the chaps), skall (shall)		
9.	snöbolls krig (snowball fight), skall (shall)		ocka (go) /åka/
10.	hoppa (jump), rullar (roll), ockso (also) /också/ skatt (treasure), opp (up)	tunor (barrel) /tunnor/ kleta (climb) /klättra/	
12.	-	alt (all) /allt/, gik (went) /gick/	-
13.	packa (pack), pappas (dad's), tensticks (matchbox) /tändsticks/, fammo (granny), faffa (grandpa), äppel, päppel, puff (rhyme), satt (sat)	paka (pack) /packa/ *kapsek (suitcase) /kappsäck/	*asck (box) /ask/ *killo (kilo) /kilo/ *krockan (the crow) /kråkan/
14.	kissa (tag), skulle (should)		
15.	katt (cat), katten (the cat) Ludde (cat's name)		vitt (white)/vit/ pojcke, (the boy) /pojke/, *
16.		*glöma (forget)/glömma/ *tveta (wash) /tvätta/, klåka (clock) /klocka/	matta (feed) /mata/ fiskarna (the fishes) /fiskarna/
17.	boll (ball), skall (shall), mycket (much), tvätta (wash)	*glöma (forget) /glömma/	matt (food), /mat/ ätter (eat) /äter/
19	-	*stube (stump) /stubbe/	fisk (fish) /fisk/
20	katt (cat), smeller (crack) /smäller/ till (to)	klöka (clock) /klocka/ matare (a firework) /mattare/	fisk (fish) /fisk/ *panssar vangn (tank) /pansarvagn/
23	gubbar (fellows)	-	-
25	Tammerfors (Tampere)		
26	Tittade	snurade(rotated)/snurrade/	
sum	39	21	14

8.3.2 Unnecessary double consonant

Chris wrote about his fishes and their food (17.1.16-21). He wrote 'mat', food, with double consonant: matt. He listened to the whole sentence with F4 and removed the last 't'. Then he listened to the whole sentence again and to the word mat, food, now correctly spelled. He went on writing about his fishes and wrote the word 'äter', eat, with double consonant: ätter (17.1.24-25). He listened to the word with F1 and then changed it to äter, which is correct.

In these two examples Chris heard from speech synthesis that something was wrong with his words, and he was also able to correct them. However, there are also examples when Chris did not notice any problem with his spelling.

When he was writing about his fishes, he wrote fisckarna (16.1.15) instead of 'fiskarna', the fishes. When speech synthesis pronounced his word, it did not clearly deviate from the pronunciation of a correctly spelled 'fiskarna'. The teacher told him that there should be no 'c', and Chris changed his word. Later (19.1.30-34) he wrote more about fishes, and then he again wrote fisck. This time, however, he immediately changed the word, and then he wrote fiskar twice with a correct spelling.

He inserted an extra 'c' also in other words with 'k'. When he wrote about a box, 'ask', in Swedish, he spelled it asck (13.1.6-9). Later in the same lesson, however, he wrote about the box again (13.1.27), and now he spelled it correctly, ask. He also wrote the word for boy, 'pojke' with ck: pojcke (15.1.42).

Almost all examples of unnecessary double consonant occur during a relatively short time: from lesson thirteen to lesson twenty (Table 7). The assessment report from the pre-test mentions that Chris, when writing single words, more often wrote double consonant where a single consonant was required than the opposite. When he wrote sentences, he did not make any mistakes with unnecessary double consonant. In the post-test he had no errors with unnecessary double consonant (Appendix 6).

8.3.3 Summarising reflections: Did Chris learn about double consonant?

How to use double consonant in Swedish is a complex of problems, and it takes many years for children to master it (Wengelin, 2013b). Chris already knew a great deal about double consonant, and there are many examples (Table 6) where he used it in the right way, also with 'ck'.

When he wrote only one consonant in words where there should have been two of them, he usually noticed it when he heard speech synthesis say the word. Sometimes the teacher encouraged him to order feed-back on a word, and then he usually noticed that something must be changed. If the word was not too long, he usually found the correct spelling of it, sometimes after a couple of attempts.

In lessons thirteen to twenty he made more mistakes when he used double consonant in words where it should not be used. In the pre-test, he wrote unnecessary double consonant when he wrote single words, but not when he

wrote sentences. He had more time to reflect on spelling when he wrote single words, and he tried out double consonant in too many places.

Chris also wrote 'ck' in words where 'k' had been enough. He was aware of the problems with double consonants, and he tried it out. He knew that 'kk' cannot be used as double consonant, it must be written 'ck', and he used 'ck' too much. It was a kind of "overuse" of double consonant, which according to Naulé (1985, 1989) can be a step on the road to full mastering of the system of double consonant.

The same words do not occur very often, so it is not often possible to follow if he had mastered the problem with double consonant in a certain word. However, two examples of this type occur, with the words "skall" and "packa". In lesson seven, when Chris wrote about his videogames, he wrote skal (L7.1.33) for 'skall' (shall, will). In the two following lessons he wrote the same word again, och i schorch skall man skuta (L8.1.11) (in schorch you are supposed to shoot), and i skiordie skall man åka skidor (L9.2.17-20) (in ski-or-die you are supposed to go on skis). The word was now correctly spelled.

In lesson thirteen Chris wrote nursery rhymes. He wrote paka (L13.1.10), the first word in the nursery rhyme "packa pappas kappsäck" (pack daddy's suitcase). Speech synthesis pronounced "paka", and Chris erased the word. After that he listened many times to another nursery rhyme that he had written. Then he started with "daddy's suitcase" again, and this time he wrote packa (L13.1.16), correctly spelled.

At least according to the two words "skall" (shall, will) and "packa" (pack), Chris learned how to use double consonant. In some lessons he made more mistakes with overuse of double consonants, but according to Naulé (1985, 1989), this is a step in the development. The assessment report of the tests mentions that less mistakes with double consonant occur in the post-test and that no unnecessary double consonants occur (Appendix 6). So, apparently, Chris learned something about the use of double consonant during the research period.

8.4 Development of Literacy Skills: What is a Sentence and how to do Punctuation?

Speech synthesis in the Ove program automatically reads the preceding text after a full stop, question mark or exclamation mark. If there are no such marks in a text, speech synthesis reads the whole text without pauses. In the first lesson the teacher showed Chris the function of the Ove program in relation to the use of full stop. In the second lesson Chris wrote only solitary words and put a full stop after every word, but in the third lesson Chris started to write sentences.

The teacher often gave a hint of a full stop when she thought that a sentence was completed, but she sometimes gave the hint too early, especially in lessons three and four. When Chris wrote about a tree: det var en gång ett träd som var

stort (once upon a time there was a big tree), the teacher suggested a full stop after the sequence, and Chris put a full stop. Then he went on writing: och det trivdes bra. (and it was happy) and finished the sentence with a full stop. This time he used the full stop on his own initiative and in the right place. The teacher noticed that she had suggested a full stop in a wrong place, and she suggested that Chris would erase it, and he did so. Chris went on with his story: men en gång kom en skogs-huggare (but once a woodman came). The teacher again suggested a full stop, and Chris followed the advice. Then he went on writing: som tänkte att det var bra ved (who thought that it was good firewood). The result was a full stop in front of a relative clause: Men en gång kom en skogs-huggare.som tänkte att det var bra ved. (L3.1.29-35, L3.2.7-18). The teacher erased the full stop in front of the relative clause, afterwards when Chris had gone back to his ordinary classroom.

When Chris in the next lesson went on writing about the tree and the woodman, the teacher again gave a hint of full stop too early, so the result was: han högg ner det. och lagade det i bitar (L4.2.21) (he cut it down. and chopped it to pieces). In a later lesson there is still one example when the teacher intruded and suggested a full stop too early with this result: i skiordie skall man åka skidor och snoubord.och ha snöbollskrig (L9.2.20-29) (in ski-or-die you can go on skies and ride a snowboard.and have a snowball fight). After that there is no example of this kind. The teacher had apparently learned to be more cautious with her suggestions.

Chris often used full stop quite independently and in the right place, also in his story about the tree, which is mentioned above. When he wrote about his computer games: det bästa spelet är doom2. (L5.2.20) (the best game is doom2.), he independently wrote a full stop after the sentence. He went on writing about his computer games during the following lessons, and he made a list of his games with a comma between the names, and a comma after the last name too. The teacher suggested that he should tell something about a game. Chris answered that he must go back and make a full stop first, and he erased the comma and put a full stop after the last name: tex ,poker,pasians, rolet, shorch, flipper, cc3, doom2, cd-man, gunboat, v-ball,skiordie. (L7.1.27-29). Only after he had changed the comma at the end of the list to a full stop, he went on writing about one of his games. He showed his understanding for the function of both comma and full stop, but he did not always make a space after a comma, and sometimes he even failed to make a space after a full stop.

Chris wrote nursery rhymes (L13.1.2-9): fem laxar i en asck (five salmon in a box), with no punctuation mark at the end. Then he started to write another word, pa, probably the beginning of the next nursery rhyme. He interrupted his writing, erased pa, and went back to his earlier rhyme and put a full stop after it. The teacher was in another room when Chris wrote this, so he was working independently. He went on writing nursery rhymes: packa pappas kapsek (pack daddy's suitcase). He listened to it with F6, and then he put an exclamation mark after the rhyme. He played with the exclamation marks and wrote many of them

and then listened to auditory feed-back (L13.1.16-30, CD4ChrisL13epi2). Chris showed that he knew how to use both a full stop and an exclamation mark. However, Chris did not always remember to finish a sentence with a punctuation mark. In lesson 13 the teacher reminded him of full stop a couple of times (CD4ChrisL13epi6). In lesson 14 he wrote about the break: jag lekte kissa (I played tag), without a punctuation mark. The teacher asked: What should we put at the end? Then Chris put a full stop after his sentence (L14.1.22-24).

In lesson sixteen Chris wrote about his pets, fishes. The teacher made the following comment in the field notes: He uses full stops rather well (L16.1.25). In lesson 26, which is videotaped, Chris wrote independently about a trip to an amusement park, and he used comma, full stop and exclamation mark adequately, and the teacher did not need to intrude (CD6ChrisL26.epi2-6). The text that he wrote appears in chapter 8.5.

8.4.1 Summarising reflections

Chris often used full stops, commas and exclamation marks in their right places. However, sometimes he did not remember to use a full stop, probably because writing and spelling demanded too much of his attention. The teacher reminded him, but not always at the right moment. Chris seemed to have a great deal of understanding of punctuation, but he sometimes failed to use it.

The teacher tried to scaffold punctuation with questioning like “What shall we put at the end of a sentence?” The questions usually had a good result, and Chris made a full stop. The function of the questioning was marking critical features of the placement of a full stop, one of the functions which Wood et al. described. The teacher also tried to scaffold punctuation with instructing, but the instructions were sometimes given at a wrong time.

One of the functions in the Ove-program which is used in this study is, that speech synthesis reads the whole sentence as soon as the writer takes full stop, question mark or exclamation mark. Strictly speaking, speech synthesis reads the text between two punctuation marks. This function can help the writer to pay attention to the function of punctuation marks.

8.5 Development of Literacy Skills: Writing a Story and Using Capital Letters

The first story Chris wrote was about a tree and a woodman, in lesson three. Most of the story appears in chapter 8.4, in connection with the use of full stop. The theme of the story was his own idea. He found the theme of the other stories in cooperation with the teacher, and all the other stories were about experiences of his own.

The Ove program does not automatically insert an upper-case letter after a full stop and exclamation mark. Chris usually did not remember to start a sentence with an upper-case letter and the teacher reminded him of that.

In lesson five where Chris wrote about his best computer game, Doom2, he independently put a full stop after his sentence, as chapter 8.4 describes. After that (L5.2.21-23) the teacher suggested that he should go to the beginning of the story and change the first letter 'j' to an upper-case letter. He did so, and he also on his own initiative changed the first letter in the next sentence to an upper-case letter. The next lesson (L6.2.22-25) he went on with his story, changed Doom2 to Pinball, and started on a new sentence. He did not remember, however, to start the new sentence with an upper-case letter. The result was:

Jag har en dator och window,och flera spel . Det bästa spelet är pinball. jag har flera andra spel. tex (I have a computer and window,and several games . The best game is pinball. i have several other games. for example)

Sometimes Chris understood the teacher's suggestions in his own way. He wrote a story about his family's pets during lessons 17-18, and he made the lines short. At the beginning of lesson 19 the story looked like this (L1.6-18), after the teacher had corrected some words which she thought were too difficult for him to spell now, for example "ihjäl" (to death):

<i>vi har en katt & några fiskar. katten är halv angora. den har bara varit hos djur doktorn en gång.den är svart & vit. Den sover på dagarna. den heter Ludde han är pojke. Fiskarnas märke är:rubin.barbi. man får inte glömma att mata dem. men man skall inte ge dem för mycket mat!! för då äter dom ihjäl sig. man skall inte glömma att tvätta akvariet.</i>	<i>we have a cat & some fishes. the cat is a half angora. it has been to the vet just once.it is black & white. It sleeps in the daytime. its name is Ludde he is a boy. The brand of the fishes is:rubin,barbi. you must not forget to feed them. but you should not give them too much food!! because then they eat themselves to death. you should not forget to clean the aquarium.</i>
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Chris made a heading for his story, in cooperation with the teacher. Then the teacher reminded him that a sentence should begin with an upper-case letter, and he changed the first letter in the first two sentences to an upper-case letter. Both the first sentences were written on their own line. The teacher started to write her field notes, and Chris went on working independently (L19.1.36-46, L19.2.1-10)). The result was this:

<i>Vår katt & våra fiskar</i>	<i>Our cat & our fishes</i>
<i>Vi har en katt & några fiskar.</i>	<i>We have a cat & some fishes.</i>
<i>Katten är halv angora.</i>	<i>The cat is half angora.</i>
<i>Den har bara varit hos djur doktorn</i>	<i>It has been to the vet just</i>
<i>En gång.den är svart & vit. den</i>	<i>Once.it is black & white. it</i>

*Sover på dagarna. den heter Ludde
Han är pojke.
Fiskarnas märke är: rubin, barbi.
Man får inte glömma att mata dem.
Men man skall inte ge dem för
Mycket mat!! för då äter dom ihjäl
Sig. man skall inte glömma att
tvätta akvariet.*

*Sleeps in the daytime. its name is Ludde
He is a boy.
The brand of the fishes is: rubin, barbi.
You must not forget to feed them.
But you should not give them too
Much food!! because then they eat
themSelves to death. you should not
forget to wash the aquarium.*

When Chris had changed all the first letters in the lines to upper-case letters except in the last one, the teacher was roused from her writing. She asked Chris when the upper-case letter should be used. He answered that they should be used when a sentence begins, and he apparently thought that a sentence is the same as a line. The teacher explained that an upper-case letter must be used after a full stop, and she helped him to make upper case letters in their right places (L19.2.11 – 37).

However, the relation between full stop and upper-case letter was probably not quite clear to Chris, even in lesson 20. According to the field notes (L20.1.2-26), Chris was willing to write about his New Year's Eve, he wrote independently, and the teacher did not intrude, she only sometimes reminded him of upper-case letters. In lesson 19 the teacher had explained that an upper-case letter must be used after a full stop, and now Chris applied that in a creative way. He wrote like this:

*. Nyårsafton
.Vi for till fiskstranden klockan 8
och skuta raketer och bomber.*

*. New Year's Eve.
.We went to the fishshore at 8 o'clock
to shoot fireworks and bombs.*

In the last lesson, 26, which was videotaped, Chris wrote a story about a visit to an amusement park CD6ChrisL26.epi2-6). He worked independently most of the time. The teacher helped him only to spell the word "snurrade" (rotated).

*först for vi till mumindalen, och
and delfinariet, och till sist for vi
till Näsineula.
i mumindalen tittade vi på tavlor.*

*first we went to the moomin walley,
the dolphinarium, and finally we went
to Näsineula (a tower).
in the moomin walley we looked at
pictures.*

*I Delfinariet tittade vi på
delfiner som gjorde konster.
Sen for vi till Näsineula.
och där tittade vi omkring neråt.*

*In the Dolphinarium we looked at
dolphins which made tricks.
Then we went to Näsineula.
and there we looked around
downwards.*

*Sen for vi till Näsineulas
restaurang. Den snurrade runt.
Sen for vi hem. Det var roligt!*

*Then we went to Näsineula's
restaurant. It rotated.
Then we went home. It was fun!*

The story is a description of Chris' experiences during the trip. He used a more complicated sentence structure now, two connected sentences and one sentence with a relative clause. He managed well to do punctuation. He began the first two sentences with a lower-case letter, but after that he began the sentences with an upper-case letter.

8.5.1 Summarising reflections

Chris usually needed a long time before he found a theme to read about. There were many discussions with the teacher, who tried to suggest themes for him and asked him about his weekend, if he had been doing something interesting that he could write about. When a theme finally was found, Chris started to write, rather willingly and quickly, and he could write on a story for several lessons. The first story, about the tree and the woodman, was the only story which Chris began without a long discussion with the teacher.

Chris wrote stories of various genres. His first story is a narrative, with elements of narrative superstructure (Alamargot & Fayol, 2009): presentation of the situation and the arrival of a problem. The other stories are based on facts. His second story is just a list of his computer games. His third story is a description of his family's pets, with a presentation of the cat and instructions for taking care of fishes. His last story, a trip to the amusement park, is a narrative with the events in temporal order and many temporal markers: först (first), till sist (finally), and sen (then).

He had hard work with learning punctuation and the relation between capital letters and punctuation. In his last story he managed rather well to do punctuation and to use capital letters. His text-writing is at the second stage relating to text-structure (Wengelin, 2013b) with more complicated sentences of various kinds.

8.6 The Use of Auditory Feedback

Auditory feedback from speech synthesis comes automatically on a word, when space bar is used, and on a sentence when full stop, exclamation mark or question mark is used. If the writer wants to hear more feedback, he or she can order feedback with an F-key.

In the first lessons the teacher showed Chris how to listen to all the text with F6, and he used it several times on his own initiative. In lesson two he was writing the word "hylla", (shelf), and he spelled it "hulla". He used auditory feedback to find the correct way to spell the word. He ordered feedback twice on "hulla", then he changed it to "hyla" and then to the correct form "hylla", and he ordered feedback on that (L2.1.26-32). Already in lesson two he could use auditory feedback to find the correct spelling of a word, "hylla". He used F6 to order feedback, which is the function that reads out all the text.

When Chris wrote the word “skogshuggare” (woodman), a relatively long compound word, he wrote it with only one <g>, skogshugare L3 (L3.1.38-43, L3.2.1-9). In chapter 8.3.1 is a detailed description about how he listened to feedback, made changes to the word, ordered feed-back with F1 for every change, and how he eventually found the correct way to spell the word.

Chris also used other F-keys than F1 and F6. He explored F2, F3 and F4 in an early lesson (L4.1.42-43), and he found out that he could listen to the previous sentence with F4. He used F4 now and then after that (L5.2.5, L9.2.2, L10.2.13). He also tried out other F-keys, F5 and F7 (L5.2.24), and he a couple of times used F5, which reads everything after the cursor (L12.1.40, L15.1.9)).

In the following lessons Chris sometimes used F1 on his own initiative to check the spelling of his words, and sometimes the teacher encouraged him to do that. When he wrote fliper for “flipper”, he asked the teacher how to spell the word, but the teacher encouraged him to listen to the word again. He ordered feed-back several times with F1 and changed his word to flipper (L7.5-8). When he wrote ploka for “plocka” (pick), the teacher again encouraged him to use feed-back, and he did so (L7.33-38).

When he wrote about his computer games in lessons 8-11, he listened to feedback which came automatically after space, and he also ordered feedback with F1. When he wrote answers to questions from the teacher (L12 – L14), he did not order feed-back on a word with F1 at all. In contrast, in lesson 13 he also wrote nursery rhymes and symbols, and he often used F-keys to listen to them. He even ordered feedback 43 times with F6 to listen to a nursery rhyme (L13.1.11).

Chris wrote about his pets in lessons 15 and 16, and he used F1 and F6 to check words, but he could also change a word after hearing feedback direct after he had pressed space. A couple of times he asked the teacher about the spelling of a word, but the teacher did not tell him the correct spelling. He succeeded to write the words using feedback, but he also showed signs of irritation.

He had written tveta for “tvätta” (wash), and speech synthesis pronounced it. He asked the teacher how to spell the word, but the teacher told him to order feedback and listen to the word again. Chris did so, but he also pressed so many keys at the same time, that the program got stuck, and the text and the log, which was not saved, disappeared (L16.16-20).

He was going to write the word “klocka” (clock) and asked how synthetic speech would pronounce it. The teacher told him to try writing it. His first version of the word was klåka, and after he heard feed-back, he changed it to kloka and finally to the correct form klocka. He carefully used speech synthesis to spell the word, but after that, he again pressed so many keys that the program got stuck and the text disappeared (L16.23-28).

Chris wrote his two last stories independently, and according to field notes, the teacher did not interfere (L20.1.3). When he wrote about New Year’s Eve, he only once used an F-key to order feedback and correct a word (L20.1.33-34). At least three times he corrected words immediately after he had heard feedback after space. When he wrote his story about his visit to an amusement park, he

worked independently and made some corrections immediately after feedback. Only when he wrote the word “snurrade” (rotated) with only one <r>, and the teacher said that one word sounded strange, he began to use F1 to find out how to spell the word. He ordered feedback with F1 for every change he made, and at last he found out what was wrong with the word (CD6ChrisL26.epi6). Chris could use feedback which came automatically after a word, and only when he needed it, he ordered feedback, mainly with F1 or F6, and then he usually found the correct spelling.

Double consonant often caused trouble for Chris and gave him an opportunity to use feedback, both to detect spelling mistakes and to correct them (8.3). Chris also had another type of spelling problem, where he could use auditory feedback, namely words in which <o> and <å> could be confused. In Swedish, words with a long vowel /o:/ are usually spelt with the letter <å>. When Chris was going to write the word “så” (so), he wrote so (L12.1.38), when he was going to write “nån” (somebody), he wrote non (L14.1.33-35), and when he was going to write the word “nyår” (New Year), he wrote nyor (L20.1.5). He corrected the words immediately when he heard speech synthesis pronounce them. He also used auditory feedback to correct words when he made mistakes with <o> and <å> in the opposite direction. Words with a short vowel /o/ is usually spelt with the letter <o>. Chris spelled “dator” (computer) as datår (L1.2.1-10), and he wrote the beginning of “kom” (came) as kå (L3.1.37), and he corrected the words when he had heard feedback.

The assessment report (Appendix 6) mentions that Chris often confused <o> and <å>, especially in the post-test. Spelling of the sound /o/ is difficult in Swedish, and the rule about <å> for a long vowel and <o> for a short vowel has many exceptions. Chris could make use of auditory feedback to find the correct spelling in many words with <o> or <å>, namely in words with regular spelling where the use of <o>/<å> was consistent with the rule of long and short vowel.

8.6.1 Summarising reflections

Chris could use auditory feedback to correct his spellings already in lesson two, with F6, which read out the whole story. In lesson three he learnt to use F1 to study a single word, and he also used other F-keys. At least from lesson eight, he could use feedback which came immediately.

It seemed that he did not want to use F-keys unnecessarily. When he wrote answers to the teacher’s questions, he did not order feedback at all, but he ordered feedback very many times to listen to nursery rhymes and symbols, which he has written on his own initiative. In lesson 16 he even made the Ove program get stuck twice when the teacher instructed him to order auditory feedback to check a word. In his last two stories he corrected words using feedback which came automatically, and he ordered feedback only when he had difficult words.

Chris could many times use auditory feedback to correct and avoid spelling mistakes in words with double consonant and in words with <o>/<å>. On the contrary, auditory feedback was of no use for spelling problems with <e>/<ä>

and for the spelling of words with the /ʃ/-sound, because the pronunciation did not reveal the spelling in these cases.

8.7 Scaffolding Writing

Scaffolding is strongly tied to the context where it happens (van de Pol et al., 2017, p 286), so scaffolding has already been mentioned in the chapters about development of literacy. This chapter will present scaffolding functions (Wood et al., 1976), scaffolding means (Tharp and Gallimore, 1988), and scaffolding as repair with a repair organization (Martin 2004). Signs of a negative affective engagement will also be discussed.

8.7.1 Scaffolding functions and means

Chris usually started to write after a discussion with the teacher about the theme for his writing (chapter 8.1.3). The teacher made questions about what he had been doing at the weekend and suggested themes for his writing. The teacher helped him to get started and even interrupted his playful writing of numerals and symbols, which can be related to the scaffolding function recruitment to task, involving “getting children not only interested, but weaned from initial imaginative play...” (Wood et al., 1976, p 98).

A hangman game with synthetic speech was used to keep up the interest in coming to lessons. At the end of the lesson Chris made a hangman riddle to his classmate, who also was a participant in the study, and in the beginning of the lesson Chris solved the riddle which his classmate has made for him. The boys were eager to make riddles to each other, and this activity diminished the frustration they could feel for the writing task, which is an example of the scaffolding function frustration control (Wood et al., 1976).

Instructing was relatively often used as a means of assisting performance (Tharp and Gallimore, 1988). The teacher instructed Chris to use feedback, especially when he had made spelling mistakes in words with double consonant (8.3.1, 8.3.2). When Chris ordered feed-back on the word, he usually noticed that there was a mistake and he tried to correct it. Only if speech synthesis pronounced the misspelled word in the same way as the correct one, the teacher gave instructions about spelling. When the teacher encouraged Chris to listen to feed-back, he usually went on working with the word, which can be related to the scaffolding function direction maintenance (Wood et al., 1976), “keeping them in function of a particular objective” (p 98). Chris usually followed the teacher’s instruction to listen to feedback, and he often managed to spell the word correctly using feedback. He could also show signs of irritation, as he did twice in lesson 16. He had asked the teacher about the spelling of a word, and the teacher, without answering his questions, instructed him to use feedback (8.6).

The teacher instructed Chris how to spell “skjuta” (shoot) (L8.1.11-16) and to use the word “hög” instead of hugde (cut, not cutted) (l4.2.7-15), but otherwise

she seldom gave instructions when Chris wrote non-phonetic words. Instructions about the spelling of words had the function of simplifying the task (Wood et al., 1976).

Instructions also concerned the use of comma (L10.2.22-25), capital letter (L10.2.9-10, L20.1.42) and full stop. The teacher tried to instruct Chris to use a full stop when he wrote the story of the tree and the woodman, but the instruction was not well timed (L3.1.29-L3.2.12, chapter 8.4). The teacher instructed him to make a full stop when she thought that he had finished a sentence, but, as a matter of fact, he went on writing it, so the full stop was in the middle of the sentence. The same thing happened a couple of times, but not in later lessons, so apparently the teacher learnt not to instruct at the wrong time.

Questioning was also a frequent means of assisting performance. Chris wrote letter strings, sometimes with a vowel and sometimes without. If there was no vowel in the letter string, speech synthesis said the names of the letters. If there was a vowel, speech synthesis pronounced it. The teacher asked Chris why speech synthesis pronounced some letter strings and not others, and after some discussion and thinking Chris found out the function of the vowel (CD4ChrisL13epi3).

The teacher asked questions about punctuation and about upper-case letters. When Chris had written a sentence about playing tag in the break, the teacher asked: What are you supposed to put at the end? Chris took a full stop, and he made full stops on his own initiative after his following two sentences also (L14.1.22-42). In the lesson before, the teacher had made several questions about what to do if Chris wanted speech synthesis to read out the actual piece of writing, namely take a full stop (CD4ChrisL13epi6). When Chris had written a story about his pets with very few upper-case letters after a full stop, the teacher asked: When should you use an upper-case letter? Chris gave the right answer: in the beginning of the sentence, but the problem was that he confused the concepts sentence and line. (L19.2.11-37, chapter 8.5).

These questions had the scaffolding function of marking critical functions (Wood et al., 1976). The questions led Chris to understand the function of a vowel in a syllable and they made him think about the circumstances when a full stop and capital letters are supposed to be used.

There is an example when the teacher tried to scaffold punctuation with a question, while Chris attended to the content of his text. Chris had written a nursery rhyme, äppel päppel piron päron puff krockan (kråkan) satt på en kvist (nonsense words, the crow sat on a twig), and he asked about the continuation of the rhyme. The teacher did not answer his question, but she made a question about what he should write at the end of the sentence. After some discussion Chris understood that the teacher wanted him to take a full stop, and he did so. Then the teacher began to talk about the continuation of the rhyme, but Chris had now lost his interest in it. – I have already written, I shall write something else, he said, and he began to write letter strings (CD4ChrisL13epi8, chapter 8.1.2). The teacher's mistake in this example is that she did not answer Chris'

question. When she tried to return to his question later, he had lost his interest in it and did not want to write more text.

Fading and the transfer of responsibility from the adult to child, which is one of the core traits of scaffolding (van de Pol, Volman & Beishuizen, 2010; Stone, 1998), occur in the last lessons. According to field notes, in lesson 20 the teacher did not intrude into his writing about New Year's Eve (L20.3). Chris wrote independently, and the only thing the teacher did was sometimes reminding of upper-case letter (L20.41-42). In the videotaped lesson 26, the last one, the teacher intruded very little, only when Chris asked questions and when he had difficulties with the double consonant in the word "snurrade" (rotated) (CD6ChrisL26).

8.7.2 Affective engagement in scaffolding

In the field notes, the teacher sometimes wrote about Chris' performance in a negative way. With the background that a collaborative interaction, affective engagement and shared understanding between adult and child is a key characteristic in scaffolding (Yelland & Masters, 2007, p 364; Stone, 1998), these comments can be a little problematic

When a visitor attended the lesson and followed the work of Chris and of the teacher (L24.2-14), Chris did not want to write. He consented only to writing answers to questions which the teacher wrote to him, and his answers were no longer than one word. The teacher wrote in the field notes that "Chris does not want to produce anything" (L24.14), but she did not mention that there was a visitor in the room, and that Chris might have been shy or afraid to show his writings to a stranger.

Chris did an Ove exercise program where the task was to find the vowel in a word (L21.6-40, and he had a rather good result, 14 points of 18. However, the teacher wrote in the field notes: "He has problems with o/å and makes wild guesses, also with consonants" (L21.31-32). He had, as a matter of fact, only twice suggested a consonant when he was supposed to find a vowel.

Some other negative notations also occur in the field notes. When Chris tried to find the text which he had written in the lesson before and he twice got another text, the teacher wrote: At last he found his text (L6.9-11). When Chris was searching for a comma and twice took a hyphen instead, the teacher wrote: Finally, he got a comma written (L10.2.22-25). Making plans for the remaining lesson the teacher wrote that the most important thing is that Chris writes and expresses himself, because it is so "enormously difficult" for him (L14.2-4). The teacher seemed to exaggerate his difficulties.

When Chris made a list over his computer games during lessons six to eleven, he spelled many English names correctly or almost correctly, for example doom2, gunboat, skiordie (ski or die) (L7.13-22) and Titus the fox (L11.3-4). It seems like a remarkable achievement that Chris, although he had some problems with writing and spelling in his mother tongue and had not yet started to study English at school, could spell the English names of computer games. However,

the teacher had not made any positive notation in the field notes about Chris's ability to write English words.

The teacher did not make any negative utterances in the videos, and the collaboration with Chris seemed good (CD4ChrisL13, CD6ChrisL26). The negative utterances appeared only in the field notes.

8.7.3 Repair as a type of scaffolding

Repair is a type of scaffolding which is used when there is a misunderstanding, some type of problem in communication, or the speaker is not satisfied with his or her utterance (Martin, 2004, p 187), or in writing, the writer is not satisfied with his or her text. A repair is comprised of three distinct parts in a repair organization: a trouble source, the repair initiation and the repair itself. A repair organization can vary in four ways: self-initiated self-repair, other-initiated self-repair, self-initiated other-repair and other-initiated other-repair. Assisted self-repair is a variety of self-repair which often occur in teaching. (Martin, 2004, pp 49-50, 104). Four examples are chosen where the activity known as repair is clearly described in field notes or can be studied on a videotape. The following four examples are analyzed according to the organization of repair.

The first example is the word "skogshuggare", woodman, where Chris had problems with the double consonant in the second part of the word and wrote it with only one <g>. Chris tried out various ways to spell the word until he found the correct one. His work with the word is also presented in chapters 8.3.1.

He had written the first part of his story about the tree and the woodman, and the last sentence was: men en gång kom en skogshugare (once a woodman came). When Chris had listened with F6 to the whole story, the teacher told him to use F1 to listen to the last word. Chris heard speech synthesis read out the word "skogshugare" with only one <g>, and he started immediately to erase letters at the end of the word (L3.1.39-40). Repair was other-initiated, with respect to the teacher's encouragement to listen with F1 to the actual word. On the other hand, he discovered by himself that something was wrong with the word when he heard it, but the initiative to listen to the word came from the teacher.

Chris made changes, and he managed to write a correct word with two <g>. This could be called an example of self-repair. Unfortunately, he did not recognize the correct word, but went on erasing and changing the word (L3.1.41-43).

Chris wrote the word in different ways until he found the correct spelling. Chris made self-repair, but he did not do everything by himself. He asked the teacher about two <g>s, but the two <g>s ended up in the wrong place. The pronunciation of speech synthesis on the word was not very good, because it was a long and compound word, so the teacher suggested a hyphen. Chris made repair in collaboration with the teacher (L3.2.1-7), and the character of repair is assisted self-repair. The organization of repair is self-initiated assisted self-repair.

The second example is from lesson sixteen when Chris wrote about his pets. He wrote man får inte glöma att matta (you must not forget to carpet), with matta (carpet) instead of “mata” (feed), which was the word he intended to write (L16.11-12). When he heard speech synthesis pronounce the word “matta” (carpet), he immediately changed it to the word “mata” (feed). The repair organization is self-initiated self-repair.

In the same line he wrote glöma for “glömma” (forget). There are special rules in Swedish for <m> in relation to double consonant, and in some positions only one <m> is supposed to be used. Because of that, speech synthesis pronounced glöma in the same way as “glömma”, and Chris had no possibility to detect a spelling mistake and to make repair.

The third example is also from lesson sixteen. Chris was going to write “tvätta akvariet” (wash the aquarium), but he wrote tveta. When he heard speech synthesis pronounce the word he asked: How is “tvätta” spelt? (L16.16-17). Chris noticed by himself that there was a problem in the word, repair was self-initiated.

The teacher asked him to listen to the word with F1, and he did so, but he also pressed so many keys at the same time, that the program got stuck. After that, when the program was started again, the teacher told him how to spell “tvätta” (wash) (L16.18-20). Chris pressed the letter keys by himself, but the teacher had instructed him to write the word, so this is an example of other-repair. The repair organization is self-initiated other-repair.

The last examples are from lesson 26, which was videotaped. Chris wrote about a trip to an amusement park. He wrote about the Moomin Walley, Mumindalen, and made self-initiated self-repair twice in the word. He mentioned a rotating restaurant and used the word “snurrade” (rotated), but he wrote it with only one <r>, snurade. - I have finished it now, he said, and he was going to stop his writing. The teacher urged him to listen when speech synthesis pronounced the sentence, and she said that a word sounded strange. Chris noticed that the strange word was /snɜːrade/ (CD6ChrisL26epi6). The teacher both told him to listen and said that a word sounded strange. Repair was other-initiated, even if he by himself noticed which word was the strange one.

Chris started to change the word, and first he wrote snnurade. The teacher encouraged him to listen to the word with F1, but the pronunciation of “snnurade” was about the same as the pronunciation of “snurade”, with a long vowel, /ɜː/. The teacher asked him what he could do to make speech synthesis say the intended word “snurrade”, and Chris started to try various vowels, <y>, <u>, <o> and back to <u> again. Then he exclaimed: two <r>s! He changed his word to snnurrade, which was pronounced quite like the intended word. The teacher told him to remove one <n>, Chris did so, and the word was correctly spelt (CD6ChrisL26epi6).

Repair was made in cooperation between Chris and the teacher in this case. Chris made the discovery that the word needed two <r>, but the teacher was active when Chris tried out various ways to spell the word. Assisted self-repair is the most suitable concept to describe what happened. The organization of repair is other-initiated assisted self-repair.

Table 8. *Repair organisation, Case 3*

Word, Sequence	Repair organisation	Lesson
Skogshuggare (woodman)		L 3
skogshugare – skogshuggare	Other-initiated self-repair	
skogshuggare – skogshugare	Self-initiated (wrong) self-repair	
skogshugare – skogshuggare	Self-initiated (wrong) assisted self-repair	
skogshuggare – skogs-huggare	Self-initiated assisted self-repair	
Glömma att mata (forget to feed)		L 16
glöma	No repair	
matta - mata	Self-initiated self-repair	L16
Tvätta (wash)		
tveta - tvätta	Self-initiated other-repair	L 16
Mumindalen (The Moomin Walley)		
mun -mum	Self-initiated self-repair	L26
mumim – mumin	Self-initiated self-repair	
Snurrade (rotated)		L26
snurade - snnurade	Other-initiated (wrong) self-repair	
snnurade – snnyrade -snnorade -snnurade - snnurade	Other-initiated (partial) self-repair	
snnurade – snurrade	Other-initiated assisted self-repair	

None of these examples are of the type other-initiated other-repair. There are some remarks in the field notes that the teacher has corrected words between lessons. She changed “besta” to the correct “bästa” (the best) and doom2, the name of a video game, to Doom2 (L6.2.28-29). The teacher also changed “glöma”, which Chris wrote twice in his story about his pets, to “glömma” (forget) (L18.1.18). These changes can be referred to the category other-initiated other-repair.

8.7.4 Summarising reflections

The scaffolding functions which appear in the collaboration between Chris and the teacher are recruitment to task, frustration control, direction maintenance and marking critical features. The function of simplifying the task appears in instruction about spelling. Instructing and questioning were two frequent means of assisting performance, and they could have various functions.

A contrast exists to some degree between more direct ways of scaffolding, for example instructions about spelling, and more indirect ways, for example

questioning and instructions of the type suggestions to listen to auditory feedback. Questioning can give the writer the possibility to find out the solution by himself and listening to feedback can give guidance for writing, but if the word is too demanding for the reader's present competence, instruction is needed. There are examples in the case where the teacher instructed at the wrong time, in lessons three, four and nine, where the teacher suggested a full stop, but Chris was going to continue the sentence.

The teacher's negative writings in the field notes are a special trait of this case. A key characteristic of scaffolding is that the interaction must be collaborative, and the learner's own intention is supposed to be the aim of the process (Yelland & Masters, 2007, p 364). A joint task engagement is essential, and central to this image are notions of affective engagement, intersubjectivity or shared understanding (Stone, 1998). With this background, the teacher's negative comments in the field notes make her affective engagement and shared understanding seem a little questionable.

The questions were not always directed to the intention of the writer. Chris asked for the continuation of a rhyme in lesson four, and the teacher responded with questioning about the need of a full stop. This kind of scaffolding, which is not directed to the writer's focus of interest, can be characterised as deficient domain contingency (Rodgers, D'Agostino, Harmey, Kelly & Brownfield, 2016).

The teacher withdrew to a great deal in the last lessons and left the responsibility for writing more to Chris. Withdrawal and transfer of responsibilities are core characteristics of scaffolding (van de Pol, Volman & Beishuizen, 2010).

Variations in repair organisation were found in the lessons with Chris, but self-initiation occurred more often than other-initiation, and other-repair occurred only once. Assisted self-repair, which often occurs in teaching situations, was found in three examples in 8.7.3.

8.8 Summary of Case 3.

Chris wrote lists of numbers and symbols and explored the keyboard, and he laughed when speech synthesis pronounced it. He wrote nursery rhymes and made word games on his own initiative, but he only once found a theme for a story by himself. When the teacher wrote questions to him, he sighed and tried to write answers with only one or two words, but on request he wrote complete sentences. When he accepted the teacher's suggestion for stories, for example, about his computer games or his visit to an amusement park, he produced relatively long texts, and writing those stories he showed no signs of being bored.

Chris had much work to do with double consonant. He often wrote only one consonant when double consonant was requested, but he also often noticed the mistake and corrected it using auditory feedback. From lesson thirteen to lesson twenty he often did the opposite mistake: double consonant when only one consonant was requested. He overused double consonant for some time, which

probably was a step forward in development. According to the assessment report, he had less errors with double consonant in the post-test than in the pre-test. Two words with double consonant which he had misspelt earlier, occurred correctly spelt in later lessons. Chris had apparently learned to handle double consonant better during the research period.

He often used full stop after sentences already in the early lessons. The greatest problem with punctuation in early lessons was that the teacher suggested full stop before Chris had finished his sentences. To use capital letters was more difficult. When the teacher reminded him of capital letter after a full stop, he made a capital letter in the beginning of every line, and after that he placed a full stop before two sentences. In his last story he used punctuation and capital letters mainly in a correct way.

Chris wrote lists of his computer games and reported about his pets and his activities, and he wrote no fantasy stories. He rapidly learned to use auditory feedback to find the correct spelling especially of words with double consonant and of words where the use of <o>/<å> caused problems.

The scaffolding functions which occurred were recruitment to task, direction maintenance, marking critical features, simplifying of tasks and frustration control.

Instruction and questioning were two frequent means of assisting performance, and they could have various functions. The teacher often instructed Chris to listen to auditory feedback. Chris usually followed the instruction and spelt correctly using feedback, but he sometimes showed signs of irritation (8.6). The teacher instructed the spelling of difficult non-phonetic words, she instructed Chris to make a full stop after a sentence, but sometimes in the wrong place, and she instructed about capital letter, but she did not always foresee the problems which could appear (8.4, 8.5).

9 Writing Stories full of Action and Exploring Double Consonant and Punctuation. Case 4.

The leading character in case four is John, nine years and in the third grade. He wrote texts with auditory feed-back from speech synthesis in a one-to-one situation with a teacher once or twice a week from September to February. Some training programs with feedback from synthetic speech were also used to give variation in the job with text writing.

John read fluently and with good reading comprehension. He had some difficulties in spelling, i.e. some problems with non-phonetic words, with double consonant and with the use of the letters <o> and <å> (appendix 8).

Twenty-seven lessons were given, and the average length of a lesson was 29 minutes. There are videotapes from two rather short, early lessons, namely lesson 12 of 16 minutes and lesson 15 of 14 minutes, and from one of the last lessons, lesson 25 of 38 minutes.

References to fieldnotes are written with lesson, page and line number, for example (L1.1.21), and references to videotapes are written with CD number, name, lesson number and episode number, for example ((CD1)JohnL25epi7). John's own writings are marked with underlining.

Chapter 9.1, 9.2, 9.3 and 9.4 deal with the first research question about development of literacy skills. Chapter 9.5 deals with the research question about use of auditory feed-back, and chapter 9.6 deals with the research question about how the teacher scaffolds writing.

9.1 Development of Literacy Skills - to Find the Urge to Write

When John and his classmate Chris, the person in case 3, were introduced to speech synthesis for the first time, they seemed to find it very amusing. They had the first lesson together. John wrote 'mamma' (mum) and laughed loudly (L.1.1.21) when speech synthesis pronounced it. Later he used F6 and made speech synthesis read out everything they had written, and he also laughed (L.1.1.24) at that.

John and Chris were also introduced to the Ove training program "Gissa ordet" (Guess the word), a type of hangman game, already in the first lesson. They could load the program with a word for the mate to guess, and almost every lesson they guessed a word and loaded a word. They seemed to be eager to do the guessing game and to write a difficult word for their classmate to guess, and that could also to some extent help them to keep up their interest for the writing project.

9.1.1 Finding something to write about

When John came to the second lesson and sat down and could start to write on his own, he said: - Now I shall write... (Nu ska jag skriva...) During the first lessons, he wrote some words and a text he remembered from his school reader. After that, in lesson five, he started enthusiastically to write a story about a knight and a terrible dragon. He wrote the story during the whole lesson, and the teacher had to interrupt him (L5.1.35) when time was out. - It is a long story (Det är en lång berättelse), he said. He wrote about the knight and the dragon during the following lessons, and when he had finished the story (L8.1.22) he said: - Now I don't know what I shall write next time (Nu vet ja int vad jag ska skriva nästa gång).

After that he did not want to go back to his story or begin a new story. Instead, he wanted (L9.1.10) to do an Ove training program. The teacher chose programs for him with the problem of double consonant, and he worked with training programs during six lessons until the teacher decided that it was time to write texts again. John did the training programs rather willingly. However, when he had worked with the programs during three lessons, he may have become a little fed-up, and then he wrote "läskipä" (L11.1.28), which is a Finnish word 'läskipää' that means something like 'blockhead'. He seemed to look forward to the lessons, anyway. In lesson 15, when he had done some more lessons with training programs with double consonant, the teacher came a little later than usual, and he asked her: (L15.1.1) "What made you be so late?" (Vad var det som tog så länge?)

He started to write a story about how a hedgehog fooled a fox, and he worked with it for five lessons. Then he wrote a story about a rescue team which saved a train from a river, also for five lessons. His last story was about a space rocket that had difficulties to get back to earth, and he worked with it during three lessons. The story about the rescue team was from a television series.

He wrote colourful stories and he worked with them for a long time, up to five lessons. In lesson 26, when he wrote about the space rocket, he did not stop when it was break time (L26.1.9) but went on writing for five minutes.

9.1.2 Playing with words and symbols

John showed his ability to play with words and to create a course of events when he wrote stories (chapter 9.4), even if the stories were inspired by films he had seen or stories he had heard.

He sometimes used symbols on the keyboard in a creative way. When he wrote a story about a fox and a hedgehog (L16.1.6), he apparently by mistake pressed the button >, and speech synthesis pronounced it: "högerhake" (right angle bracket). He went on with the story, and he wrote that the fox asked the hedgehog about his name. He wrote the hedgehog's answer with < (L16.1.16), and the result was: <, sa igelkotten (<, the hedgehog said). When speech synthesis read out the sentence, the name of the hedgehog was "Vänsterhake"

(Left Angle Bracket). After that, John referred to the hedgehog with the name Vänsterhake (Left Angle Bracket) through the whole story (chapter 9.3.3).

John managed to find amusing words even when he was doing the Ove exercise programs with single and double consonant. When he worked with an exercise program with rhymes, he was supposed to fill in a rhyme to “en gris i en ...” (a pig in a ...). The right answer should be “en gris i en spis” (a pig in a rig). John gave a more humorous response (L9.1.20) instead of that: en gris i en bar (a pig in a bar).

When he had worked through an exercise program with contrasting words of the type full (full)/ful (ugly), he started to make examples (L10.1.9-11) of his own: mamma (mum)/mama, pappa (dad)/papa. The second word in the pairs is a nonsense word, but the word pairs are contrasts just like the words in the exercise. He also completed a list of rather dull words in exercises with a more exciting word, läskipä (Finnish: blockhead), which is mentioned above, and myr-piggsvin (echidna) (L12.1.13-16).

9.1.3 Summarising reflections

It was an amusing experience for John to listen to auditory feed-back from speech synthesis on the words he wrote, at first at least (L.1.1.21-24), and it helped to inspire him to write words and texts. He began gradually to write longer and more dramatic stories, mostly from books and television series, and now the telling of the content of the stories seemed to be the inspiration for his writing.

9.2 Development of Literacy Skills: Writing Words

John wrote simple words well, also words with many consonants like hemsk (terrible) (L4.1.6,8) and plötsligt (suddenly) (L5.34). He understood the entity of a word and he rapidly learned to make spaces after words also in sentences (chapter 9.5).

He had some problems with the vowel in words like “blå” (blue) and “tåg” (train). He first wrote blo (L8.1.9) and tog (L20.1.15), but when he heard auditory feed-back, he changed the words (chapter 9.5.1). He also had some problems with the short vowel <o> and <å> in words like “storm” (tempest) which he usually wrote correctly (L20.11) but sometimes wrote like stårm (L22.1.15), and with the irregular “gång” (time) which he wrote gong (L4.1.8, L15.1.13-14). He had no use of auditory feed-back for the spelling of these words, because the correct and the incorrect spelling were pronounced in the same way.

John usually wrote phonetically spelt words correctly, except words with double consonant. In lesson two, but not later, he had some difficulties to distinguish /k/ and /g/, when he wrote gardemumma for “kardemumma” (cardamom) (L2.1.22-26). He had some problems with the sounds /ʃ/, /ç/ and /ŋ/, which are spelt in various ways in Swedish. He sometimes spelled words with /f/ correctly, like sjön (the lake) (L6.1.24) but he had problems with words

where the /f/-sound was spelt in a more difficult way like “station”, which he wrote stasjon (L21.1.12-16) and “passagerarna” (the passengers) which he wrote pasaserarna (L23.1.11-15). He managed to write words with /ŋ/ which are spelt with the most frequent way of writing the sound, like “gång”, but he had problems with more infrequent ways of writing /ŋ/.

9.3 Development of Literacy Skills: The Problem with Double Consonant

John wrote one or two words with double consonant quite correctly every lesson from the first lessons (table 9). More often, however, he wrote such words with only one consonant. He usually noticed from auditory feed-back when there should be a double consonant, and usually also managed to correct the words (CD4|John12epi3-4). Only in a few words he tried to write a double consonant where there should be only one. Sometimes he tried to write words with a double vowel.

9.3.1 A single consonant instead of double consonant

In the second lesson (L2.1.1-5) John whispered the word “grabb”, (boy), and wrote: grab. When speech synthesis pronounced the word, he exclaimed: “It said gra:b! Should be two r!” (Den sa gra:b! Med två r!). He erased the word and wrote: grrab. “Should be two a!” (Med två a!) he said after he heard speech synthesis say the word. He erased again and wrote: graab. “It said gra-ab” (den sa gra-ab), he commented. Then he erased and wrote grabb, with the correct spelling. The teacher had been passive, and John had independently explored how to spell the word “grabb”.

Later during the same lesson John was going to write the word “kardemumma”, (cardamom), and he spelled it gardemuma (L2.1.22-26). When he heard speech synthesis pronounce the word, he repeated it in a whispering voice, and the teacher asked if he thought that the word sounded a bit strange. Now he, for the first time, used F1 to listen to the word he had written. The teacher had probably told him about F1 and asked him to use it. He changed the word to gardemuuma. He listened with F1 again, and then he changed the word to gardemumaa. He listened with F1 and changed it to gardemumma. He listened to the word twice with F1, and then he went on writing other words. With her question, the teacher had confirmed that something was strange with his first spelling gardemuma, and she showed him the function of F1. After that John independently worked with the word, and he tried out different ways to spell it until he found a way which was nearly the right one.

The teacher said nothing about the first letter in “gardemumma”, which should be <k> and not <g>. After the lesson the teacher changed “gardemumma” to “kardemumma” in John’s text (L.1.2-4), so when he listened to and read his text

in the next lesson, the word was correctly spelled with <k>. John wrote more text about the girl who went to the shop to buy cardamom, and now he spelled the word quite correctly (L3.1.11).

When John wrote texts, he often wrote only one consonant where double consonant was the norm. When he heard speech synthesis pronounce the word, he usually noticed that something was wrong, and he usually quickly found out how to write the word in the right way. For example, in lesson seventeen, when John wrote about a hedgehog and its spines, taggar, he wrote tagar and not “taggar”. When he heard the speech synthesis pronounce /ta:gar/, he immediately inserted <g>, and listened to the correctly spelled word “taggar” with F1 (L17.1.14). In lesson 22 John was going to write “släpp” (let go), but he wrote “släp”. Speech synthesis pronounced it with a long vowel, John inserted <p> and the word was correctly spelled. John made these changes independently, without help from the teacher.

Sometimes, with a longer word, for example “fortsatte” (continued), John had difficulties (L16.1.21-28). He wrote fortsate, and then he complained over how it was pronounced. He tried four different ways of writing the word, forttsate, fortssate, forrtsate and even fortsaate, until he found the right solution. Even in lesson 24, when he wrote the word “knuffa”, push, as knufa (L24.1.7-9), he tried two impossible types of spelling: knuufa and knnufa, until he found the right one. Only in four cases (table 7), words with one consonant instead of double consonant were not corrected at all.

In three of the words which were not corrected, the missing consonant was <n>. There are special rules for <m> and <n> in Swedish, and sometimes a word with a single <m> or <n> is pronounced just like a word with double consonant of <m> or <n>. Because of that, speech synthesis pronounced mänen, tuna and fans in the same way as the correct “männen” (the men), “tunna” (barrel) and “fanns” (there was), and John had no chance to detect his spelling mistake.

Table 9. *Overview of the use of double consonant, Case 4*

Lesson	Double consonant correct at once	Single consonant instead of double consonant. Correct spelling in slashes	Double cons. instead of single cons. Correct spelling in slashes	Double vowel. Correct Spelling in slashes
1.	mamma (mum)	-		
2.	kommer (is coming) mamma (mum)	**grab (boy)/grabb/ anika /Annika/ **gardemuma (cardamom) /kardemumma/ ruf (dog's name) /Ruff/ papa (dad) /pappa/		
3.	kardemumma (cardamom), ruff /Ruff/			
4.		**sate (put) /satte/ stele (place)/ställe/		
5.	riddaren (the knight) skulle (should) hoppade (jumped)	stäle (place)/ställe/		
6.	opp (up)	*mänen (the men) /männen/, sit (his)	kastadde (threw)/kastade/	
8.	upp (up)	föl (fell) /föll/	Kllaus/Klaus/	
9.		*tuna (barrel) /tunna/ dam (pond) /damm/ bruga (bridge) /brygga/		
10.		papa (dad) /pappa/		aapa (monkey)/apa/
11.	glass (ice-cream)	veser (sharpens)/vässer/ båk (he-goat)/bock/ tak (thank you)/tack/ sil (herring) /sill/ tiger (beg) /tigger/	vägg (road), /väg/	bruun (well) /brunn/
12.	tall (pine-tree),vass (reeds) sill (herring) lönn (maple) vägg (wall), glass (ice-cream)	sopa (soup)/soppa/ hög (cut)/högg/ myrpigsvin (echidna) /myrpiggsvin/	full (ugly)/ful/ damm (lady) /dam/	
13.		Tak (thank you) /tack/		
15.	Igelkotten (the hedgehog) gick (went)			
16.	hoppade (jumped)	**fortsate (went on) /fortsatte/		

	komma (come), till (to)			
17.	gick (went)	fik (got) /fick/ tagar (spines) /taggar/		
20	ett (a), vatten (water)	*fans (there was)/fanns/		
21	föll (fell), att (that) vattnet (the water) har fallit (has fallen)	stormfågelpatrulen (the fulmar patrol)/stormfågel- patrullen/		
22	kommer (is coming)	*fans (there was)/fanns/ SLÅP! (let go!) /släpp!/ **knufa (push)/knuffa/ *pasaserarna (the passengers) /passagerarna/ hiner (manage) /hinner/		
23	oss (us)	**hete (was called)/hette/ nyt (new)/nytt/		
25	oss (us)	räda (rescue)/rädda/		
26		skika (send)/skicka/ lykades (succeeded)/lyckades/		
27	skall (shall), pappa (dad) gubbe (fellow), fick (got) lyckades (succeeded) också (also)			
sum	35	40	5	2

* John did not correct the word **John tried double vowel when he corrected the word

9.3.2 Unnecessary double consonant and double vowels

In texts, John very seldom wrote double consonant in wrong places. There are only two examples, in lesson six and in lesson eight (table 9). When he was working on correcting a word that he had written with only one consonant instead of the necessary double consonant, he sometimes tried double consonant in the wrong place (9.3.1).

When he did the Ove training programs with single and double consonant, he made some mistakes and wrote a double consonant where a single consonant had been the right choice. In the Ove programs there are many exercises with contrasting words, for example “ful” (ugly) and “full” (full). “Ful” is pronounced with a long vowel, and a long vowel is followed by only one consonant. In lesson eleven and twelve, doing training programs, he wrote unnecessary double consonants (table 7) in some words. However, there are more examples of words where he wrote a single consonant when the norm is a double consonant, also in the lessons when he had been working with Ove training programs.

John sometimes wrote words with a double vowel, not when he wrote texts, but only when he did exercise programs and when he tried to correct spelling mistakes. In lesson ten he had done some exercises with contrast words like “full” and “ful”, and then he made up some examples (L10.1.8-13) himself: “mamma (mum) / mama” and “appa / apa” (monkey, ape). “Mama” and “appa” are nonsense words, but they fit into the system with contrast words. John wrote the word for monkey, “apa”, with a double vowel like this: aapa. When he heard synthetic speech pronounce it, like /a-apa/, he changed his word to a correct apa. In lesson 25 he wrote the word “hette” (was called) incorrectly as hete, and when he tried to correct the word, he wrote heete. After a discussion about vowels, he changed it to the correctly spelt hette (was called) (L25.1.4-6)

9.3.3 Did John learn about double consonant?

Table 9 is an overview John’s use of words with double consonant. There are some words in which John made a spelling mistake with double consonant in an early lesson, then listened to auditory feed-back and corrected the word. When the words appeared in a late lesson, he spelled them right. The words are “pappa” (dad), “föll” (fell) and “fick” (got).

In the second (L2.1.34-35) lesson John wrote the word ‘pappa’ (dad) with only one <p>: papa. When he heard speech synthesis pronounce it, he changed it immediately to pappa, and listened to it. The same thing happened in the tenth lesson, but in the last lesson (L27.1.10-11) John again wrote the word pappa in a story, and now he spelled it correctly at once.

In lesson eight John wrote about a knight who fell into a lake when he was going to kill a dragon. He wrote the word “föll” (fell) with only one <l>: föl, which means a foal. When he heard the speech synthesis pronounce the word with a long vowel, he changed it to föll. When John later wrote about a train which fell into a river (L21.1.11), he spelt the word ‘föll’ (fell) correctly at his first attempt.

When John wrote about a fox who got hedgehog spines in his nose, he wrote the word “fick” (got), with only one consonant: fik (L17.1.13). He heard speech synthesis pronounce it like /fi:k/, and changed it to fick, which is correct. In the last lesson (L27.2.12) John again wrote the word fick (got), and now he spelled it correctly at once. These three words, “pappa” (dad), “föll” (fell), and fick (got), were not correctly spelt in an earlier lesson but were correctly spelt later. Learning has apparently occurred in the meantime. Of course, it is not possible to know what exactly has led to learning of the words, writing with auditory feed-back from speech synthesis, daily schoolwork, or something else.

There are also three examples where John spelt a word wrong, corrected it, and then spelt it right later in the same lesson or in the next lesson. In lesson two John wrote about a girl who went to the shop to buy cardamom and took the dog with her. Chapter 9.2.1 describes his struggle with the word ‘kardemumma’ (cardamom), (L2.1.22-26). He wrote (L2.1.28-31) the dog’s name, Ruff, in this way: ruf. He heard synthetic speech pronounce the word, and then changed it to ruff. In the next lesson John went on with the story (L3.1.11-14). Now he spelled

kardemumma right at once. He also spelled the dog's name, Ruff, right, ruff, only with exception of the upper-case letter.

In the last lesson John wrote (L27.1.15-17) the word "lyckades" (succeeded) first like this: lykades, then changed it to lukades, and then to luckades. On the recommendation of the teacher he changed <u> back to <y>, and then he had the word written in the right way: lyckades. Later during the same lesson (L27.2.19) he wrote the word lyckades (succeeded) again. Now he immediately spelled it right.

John had the text before his eyes in these three cases, and he could of course have checked from the text how to spell the words right. However, he quickly wrote the words in the right way, and he seemed to know how to spell them.

On the other hand, there are a couple of words which are wrongly spelt every time they appear. John wrote the word "ställe" (place) with a single consonant, stele in lesson four and stäle in lesson five, and he spelt the word "tack" (thank you) as tak both in lesson eleven and lesson thirteen. He changed stele to stelle (L4.1.14-15) and tak to tack (L11.1.16-17) after hearing feed-back, but he still wrote the words with a single consonant when he wrote them again later.

9.3.4 Summarising reflections

There are spelling mistakes with double consonant in almost all lessons, also in the late ones (table 9). That is natural, because the system of double consonant is deemed to be the most difficult item in Swedish spelling (Wengelin, 2013 b), and more than half of all spelling mistakes that children make in Swedish are mistakes with the system of double consonant (Elbro, 2004).

Six words appear, first with spelling mistakes on double consonant, and later, with no spelling mistakes. John seems to have learned how to spell these words. He has probably learnt to spell other words too, but these are the only ones which first appear in a misspelt version and later are spelt according to the norm. Two words appear twice in a misspelt version. Although these words had been corrected according to auditory feed-back in their first version, learning does not seem to have happened.

John's results in the spelling tests are clearly better in the post-test than in the pre-test (appendix 8). However, there are spelling mistakes with double consonant also in the post-test.

John sometimes wrote words with double vowel, which is not an option in spelling in Swedish. When he had made a mistake in a word with double consonant and he used auditory feed-back to discover how the word should be spelt, he sometimes tried double vowel, but he did not write double vowel when he wrote a text.

When the teacher gave the rule "never two vowels" (L25.1.4-6), she presupposed that John knew the vowels. During the hangman game the teacher gave him the hint to start with guessing at vowels, and the teacher and John mentioned the vowels together (L7.1.7-9). Later when John guessed at words, he started with <A> and <E> and said "vowels" (vokaler) (L13.1.6). In lesson fifteen

he started the guessing game with vowels, and, apparently, he knew the vowels at that time.

9.4 Development of Literacy Skills – Writing a Story with Punctuation Marks and Capital Letters

John showed already in the first lessons that he knew a great deal about the structure of sentences. He knew something about how to use a full stop, and other punctuation marks also, and to start a new sentence with an upper-case letter.

John's text from Lesson 2:

annika kommer från skolan snart. Då kan hon gå ut och tjöpa gardemumma och ta Ruff med sig. Hej mamma och pappa.

(annika will soon come from school. Then she can go out to buy cardamom and take Ruff with her. Hello mum and dad.)

9.4.1 Finishing a sentence with a full stop

When the writer finishes a sentence with punctuation in the Ove word processing program, speech synthesis pronounces the whole sentence. The first time when John showed that he was aware of the use of full stops was in lesson two. He wrote some words (L2.1.5-6), listened to them with F6, exclaimed: "Hups!" (Oops!), and then finished the range of words with a full stop. In lesson three he completed a sentence with a full stop on his own initiative. He wrote: Jag ska gå och köpa kardemumma. (I shall go to buy cardamom.), and, according to field notes (L3.1.11), the teacher did not remind him of the full stop.

In lesson five John wrote a sentence about a knight and a dragon, and he finished it with a full stop (L5.1.16). When speech synthesis read the sentence, he showed his joy by waving both his hands up in the air. Then he wrote that the knight said: - Jag är på ett farligt stäle (I am in a dangerous place), and he had no punctuation mark after that (L5.1.19-22). When he had written that, he exclaimed "Hups!" (Oops!), and then he put a full stop after the last word and listened to the sentence. The teacher believed that Joni reacted with his "Hups" (Oops) to the word stäle, which was a spelling mistake, the correct spelling is "ställe" (place). But John explained that he said so because he noticed that he had not remembered to make a full stop.

John's text from lessons 4 – 8:

Den hemske draken.

Det var en gång en hemska drake som satte eld på varje ställe.

En riddare skulle strida mot den hemske draken. Riddaren gav sig av.

- Jag är på ett farligt ställe.

Plötsligt hoppade 4 män på honom. Riddaren sparkade på en av mänen men det hjälpte inte. De 4 mänen kastade riddaren i sjön. Riddaren spolades upp

vid draken just när draken tänkte spruta eld på kungens borg. Riddaren kastade sitt svärd på drake.

-Men vad nu.Draken steg upp och var blå.Draken bröt av svärdet.Draken sprutade på riddaren. Riddaren kastade kniven.SPPLATTC.Riddaren föll ner i sjön och klarade sig. Slut.

The terrible dragon.

Once upon a time there was a terrible dragon who set fire to all places.

A knight was going to fight the terrible dragon. The knight set off.

- I am in a dangerous place.

Suddenly 4 men jumped on him. The knight kicked one of the men but it had no effect.The 4 men threw the knight into the lake. The knight was washed ashore beside the dragon just when the dragon was going to breathe fire at the king's castle. The knight threw his sword at dragon.

-But what.The dragon rose and was blue.The dragon broke the sword.The dragon breathed on the knight. The knight threw the knife.SPPLATTC.The knight fell into the lake and made it. The end.

John used a hyphen to introduce the knight's utterance (L5.1.19). He used a hyphen before an utterance also in the story about the fox and the hedgehog (lessons 15 – 18) and in the story about the Fulmar rescue group (lessons 21 – 27).

When John wrote the story about the terrible dragon, the teacher reminded him to make a space after a full stop (L6.1.17, L8.1.14-15). If the teacher did not remind him, he usually failed to make a space after a full stop.

In later lessons, John usually finished his sentences with a punctuation mark. When he sometimes wrote two sentences in a sequence without a mark between them, he later noticed that something was wrong, and inserted a full stop. He told a story of a rescue team (L20.1.15-17), and he wrote: Ett tåg skulle köra över en trasig bro under bron fans det vatten. (A train was going to drive over a broken bridge under the bridge there was water.) When he later listened to his text (L24.1.3) he suggested a full stop after en trasig bro (a broken bridge).

9.4.2 Other punctuation marks

John also used other punctuation marks. He asked the teacher how to make an exclamation mark, and the teacher showed him (L2.8-9). However, he did not use an exclamation mark after a sentence until in lesson seventeen, in the story about the fox and the hedgehog. In the story about the Fulmar rescue team (L27), he made several exclamation marks: vi kommer att överleva!!!! (we will survive), and he made the exclamation marks completely on his own initiative.

In lesson sixteen he started to use commas, also in the story about the fox and the hedgehog. In lesson 21, in the story of the Fulmars, the teacher suggested a comma, and after that he used commas several times in the story (L22.1.8-9, L23.1.10-18). He used a question mark for the first time in the last lesson when he wrote the following question: - Brains vad skall vi göra? (- Brains what shall

we do?) (L27.2.14). The teacher had given him a hint that a question needs something, and then he immediately made a question mark.

9.4.3 Upper-case letters

John knew that upper-case letters are supposed to be used at the beginning of a sentence. In lesson three, when he wrote about Annika and Ruff, and he was going to begin a new sentence, he asked the teacher how to make an upper-case letter, but he found out himself how to do it (L3.1.8). He also made a full stop after the sentence on his own initiative (L3.1.11). When he started with the next sentence, he wrote a lower-case letter at first, exclaimed “hups” (oops) and changed it to an upper-case letter (L3.1.13).

Still, he sometimes failed to begin a sentence with an upper-case letter, especially when he was eager to start writing. When he wrote the story about the terrible dragon, he mostly made upper case letters and full stops by himself (L5.1.6-17, chapter 9.3.1). In the story about the fox and the hedgehog he began many sentences with an upper-case letter, but in three sentences the teacher had to remind him of it (L18.1.10). In lesson 25 he was eager to start his story about a rescue team, and once he failed to begin a sentence with an upper-case letter until the teacher reminded him (CD1JohnL25Epi7), although he usually managed to use upper-case letters in the last lessons, namely lessons 25-27.

John’s text from Lessons 15 -18:

Igelkotten och Räven

*En gång gick en Igelkott på en stig. Plötsligt hoppade en räv fram.
Kan du komma till mig, sa räven.
-Nej, sa igel-kotten.
-Vad heter du, sa räven.
-<, sa igelkotten.
-Kan jag komma till dig, sa räven.
-Nej, sa <.
Räven sprang vidare <fortsatte sin vandring. Plötsligt hörde < ett yl. < gick dit och såg räven död! < vände sig. Räven hoppade på on igelkotten och fick taggar på nosen. Slut.*

The Hedgehog and the Fox

*Once a Hedgehog went on a path. Suddenly a fox jumped forth.
Can you come to me, the fox said.
- No, the hedge-hog said.
- What is your name, the fox said.
-<, the hedgehog said.
-Can I come to you, the fox said.
-No, < said.
The fox ran further < continued his wandering. Suddenly < heard a howl. < went there and saw the fox dead! < turned around. The fox jumped the hedgehog and got spines into his nose. The end.*

John used the symbol < for the name of the hedgehog, and speech synthesis pronounced the symbol as “vänsterhake” (left angle bracket) (chapter 9.1.2). He made the lines short, and he did not wait until the Ove text processing program automatically took a new line.

9.4.4 Story writing

John did not write about his own experiences. His texts are from stories he had read or heard. The first text about Annika is from a school reader (L2.1.11). The story about the terrible dragon, is, according to John, “from something else that we have written” (L4.1.5). The story of the hedgehog and the fox is a fable (L16.1.5), and the texts about the Fulmar Rescue Team (Appendix 9) are from television series. Anyhow, he told the stories in a vivid way, and he also made some contribution of his own, like the name of the hedgehog, <, Left angle bracket.

The story about Annika is a simple narrative, but all the other stories have elements of a narrative with a superstructure. There is a presentation of persons, a dragon, a knight, a hedgehog and a fox, and a presentation of places, a broken bridge over water and a space rocket. Then a danger appears, a fire-breathing dragon and his violent servants, a fox which wants to eat a hedgehog, a train accident and difficulties for a space rocket to get back to the earth. The principal characters must fight these problems and win over them in the end.

There is a dialogue in all the stories. There are connected clauses, among them some relative clauses. In the story about the hedgehog and the fox (chapter 9.3.3) there are questions, but no question marks. In the last text about the Fulmar Rescue Team (Appendix 9) there are questions and exclamations, and both question marks and exclamation marks are used.

9.4.5 Summarising reflections

Because punctuation, capital letters and spaces between words are a property of written language and not of spoken language, children must learn to use them, and that can take time. John had already in the first lessons some understanding of punctuation. In the last lessons he used punctuation regularly, although he sometimes failed, especially when he was eager to write. John seemed to notice mostly by himself how to use punctuation and capital letters. The only item for which he needed the teacher to remind him was to make a space after a full stop.

Speech synthesis in the Ove program pronounces a string of words when the writer takes a full stop, an exclamation mark or a question mark, which can make the writer more aware of the function of punctuation.

John did not write about his own experiences, but he retold stories, often with a dramatic content and a narrative superstructure (Alamargot & Fayol, 2009). Relating to text structure, John’s text-writing is at the second stage (Wengelin, 2013b) with more complicated sentences of various kinds.

9.5 The Use of Auditory Feedback from Speech Synthesis

John soon learned to listen to feedback and to change his words if needed. A little later he learned to order feedback on his words and sentences with F-keys. In lesson six John showed that he could independently use the auditory feedback from speech synthesis which came automatically when the spacebar was pressed after a word. When he had written kastadde (threww), he laughed when he heard speech synthesis pronounce it (L6.2.3-4), erased <d> and corrected the word to kastade (threw). Immediately afterwards he wrote sit (his), with only one t-letter instead of two (L6.2.5-6). When he heard speech synthesis pronounce /si:t/, he imitated /si:t/, and then he corrected the word to sitt (his). He did the changes without help from the teacher.

From lesson twelve John started to order feedback from speech synthesis on a word with F1 on his own initiative. He tried to write a long word, “myrpiggsvin”, (echidna), and he wrote it with only one ‘g’, myrpiggsvin (L12.1.13-16). The Ove speech synthesis does not pronounce long and compound words very well, so the teacher inserted a hyphen, encouraged John to use F1, inserted another hyphen, myr-pig-svin, and encouraged John to use F1 again. When the teacher said that one letter was missing and that there should be two of them, he first guessed <s> and then <g>. When he had inserted the missing <g>, the teacher pointed to F1 and John listened to the word with F1. Then, on his own initiative, John took F1 and listened to the word again (CD4JohnL12epi11).

After that he wrote a string of letters, ikljöjä, and ordered feed-back with F1 five times, and he laughed when speech synthesis pronounced his string of letters (CD4JohnL12epi13). When he wrote his story about the fox and the hedgehog in lesson sixteen, he used F1 many times (L16.1.14-30), especially when he corrected words. In all the following lessons he used F1. Later (L22.1.11-19) he also used F2 to order feed-back on the latest sentence.

9.5.1 Auditory feed-back on words

If an omission of a letter happened in a word, John could complete the word after hearing feedback. When he had written vanding for “vandring” (wandering) (L16.1.29-30) and sctt for the name Scott (L22.1.9), he inserted the missing letter when he had heard feedback on the word.

The words which John corrected with the help of auditory feedback belonged mainly to two groups. The first group was words with double consonant, and the second group was words with a long /o:/-sound, which are spelt with <å>.

In chapter 9.3.1 there are many examples where John used auditory feedback to correct words, especially words where a double consonant is required. Sometimes he corrected a misspelling at once when he had heard feed-back, like the example above where he changed sit to the correct sitt (his, her), and in lesson 27 where he changed skika to skicka (send). Sometimes he tried various

ways to write the word until he found the right one, like in the examples with “grabb” (boy), “kardemumma” (cardamom), and “knuffa” (push) in chapter 9.3.1. Words where the double consonant was <n> could be a problem. A single <n> was in many words pronounced by auditory feedback in the same way as a double <n>, because of the special rules for <m> and <n> in Swedish spelling (9.3.1).

The other group of words where John used auditory feedback to find out how to spell, was words with a long /o:/ sound, which are spelt with <å>. In lesson two he wrote fron, and not the correct “från” (from), and he did not notice his mistake when he listened to feed-back (L2.1.15-17), and the teacher corrected it afterwards. In the later lessons he noticed from auditory feedback when he made mistakes of that kind. He was going to write “blå” (blue), which is pronounced /blo:/, but he wrote blo (L8.1.9-10). When he heard speech synthesis say “blo”, /blu:/, he exclaimed. – Oohh! Then he changed the word to blå. He wrote about a train, “tåg” (L20.1.14-15), and about a box, “låda” (L22.1.12-13, but he wrote tog and loda. When he heard feedback on the words, he changed them immediately to tåg and låda. In a later lesson he wrote more about the train, “tåg”, and now he spelled it right at once. In lesson 25 John wrote senaste nyt från oss, (the latest news from us), with spelling mistakes both with double consonant and o/å. When he heard feedback, he changed the words to the correct shape nytt and från (CD1JohnL25epi16).

There were some word types for which auditory feedback was of no use, for example the various ways to spell words with /ç/, the “tje-sound”. When he was going to write the word “köpa” (buy), he spelled it tjöpa, in the other possible way of writing /ç/ (L2.1.20-21). Auditory feedback in the Ove Program pronounces all possible spellings of /ç/ in the same way, and according to the field notes John looked happy when he heard the feed-back and exclaimed: - He said it! (Den sa de!). The teacher did not try to teach John the various ways of spelling /ç/, but she changed his tjöpa to the correct “köpa” after the lesson (L3.1.2). He continued his story in the next lesson, and he wrote köpa again, now correctly spelt (L3.1.11).

There were also other types of spelling mistakes which John could not discover with auditory feedback, for example the problem with <e> and <ä> in words like “hjälp” (help) and “ställe” (place). He spelled hjelp (L6.1.9-11) and stelle (L4.1.15), and the words were pronounced in the same way as if they had been spelled with <ä>. The teacher showed him the correct spelling of the word “hjälp” and changed stelle to “ställe” after the lesson (L5.1.5).

Various ways of spelling /ŋ/ were also pronounced in the same way by speech synthesis. John wrote several words with the most frequent spelling of /ŋ/ quite correctly, like sprang (ran) and vandring (wandering) (L16.1.20-30). When he was going to write “signal”, he spelled it singnal (L27.1.9-19), and it was pronounced in the same way as the correct “signal”.

9.5.2 Auditory feedback on text structure

John also used auditory feedback to check text structure. If two words are written with no space between them, speech synthesis pronounces them as one word. John sometimes wrote words with no space between them, especially in the first lessons. He wrote fronskolan (fromtheschool) (L2.1.15-16), and after he had heard feedback, the teacher helped him to make a space. When he wrote the story about the terrible dragon (L4.1.6-16), he again failed to make spaces, and the teacher helped him with that. Then he wrote two words without space again, drakesom, (a dragonwhich), and now, when he had heard the auditory feedback he independently inserted a space. In lesson fifteen he wrote two words without a space and with a spelling mistake, engong (once, two words in Swedish). After hearing feedback he immediately inserted a space, en gong (L15.1.12-13). In the following lessons he usually made spaces after words, but once he failed to make a space. He was going to write “sa igelkotten” (said the hedgehog), and when he had written saig, he noticed his mistake, erased <g> and <i> and made a space after the word sa (L16.1.12-13).

John could use auditory feedback to check text structure according to sentences. When a sentence was completed with a full stop, a question mark or an exclamation mark, speech synthesis pronounced the sentence. In his story about the Fulmar Patrol that rescued the train, John twice wrote two sentences together before he made a full stop (L20.1.15-17, L21.1, chapter 9.4.1). When he later listened to his story, he inserted the missing full stops.

John made comments on the quality of the speech synthesis. When he listened to his story about the knight and the dragon (L8.1.2), he said that Ove is from Sweden. When he wrote the word och (and), speech synthesis pronounced it like /o/, as it is pronounced in everyday speech. John imitated it and said: “Den är rikssvensk ändå” (however, he is from Sweden).

He also commented the pronunciation of the word “myrpiggsvin” (echidna) and said that Ove spoke in his nose. He squeezed his nose with his fingers and imitated Ove’s pronunciation of “myrpiggsvin” several times (CD4|JohnL12epi11).

9.5.3 Summarising reflections

John often used auditory feedback as an aid in the spelling of two groups of words: words with a double consonant and words with /o:/. Both problems with double consonant and confusion with <o> and <å> (/u:/ and /o:/) are mentioned in the assessment report as difficulties in writing for John (appendix 8). Auditory feedback made it possible for John to study and to discover the spelling of words that belonged to the categories that were difficult to him.

There are special rules for the spelling with <o> and <å> in Swedish. A long /o:/ sound is usually spelt with <å>, with some exceptions. A short /o/ sound is usually spelt with <o>, also with some exceptions. If John wrote a word with a long /o:/ sound with <o>, like “tog” for “tåg” (train) (L20.1.14-15), speech synthesis pronounced the word /tu:g/, and he could hear from auditory feedback

back that he had made a spelling mistake and change it. If he wrote a word with a short /o/ sound with <å>, like “stårm” for “storm” (L22.1.15,26), speech synthesis pronounced both “stårm” and “storm” in the same way, and in these cases the teacher had to give a hint about spelling.

John could use auditory feed-back to find the correct spelling for almost all phonetically spelt words and he used it on his own initiative. Words which are not phonetically spelt could usually not be handled in that way, for example words with the sounds /f/, /ç/, /ŋ/ and the sound /o/. The teacher had to take a more active role in the cases when auditory feed-back did not give the cues for spelling. In the early lessons the teacher corrected spelling mistakes of that kind in John’s text after the lesson, and in the later lessons the teacher showed him how the words were supposed to be written.

9.6 Scaffolding Writing

John had no difficulties in finding something to write about, and he wrote his texts rather easily (chapter 9.1.1). The teacher did not need to make any great efforts to recruit him to the task. The teacher was passive when John wrote stories, especially in the last lessons. Only when a problem appeared, like a misspelled word or difficulties to make a speech mark, the teacher intruded (CD1JohnL25epi5-16), otherwise John wrote independently and used auditory feed-back. Scaffolding was fading away in the late lessons and the responsibility for writing was moving to John himself.

9.6.1 Scaffolding functions and means

The teacher sometimes gave direct advice to John on his writing, especially about full stops and upper-case letters. For example, when John wrote a name (L22.1.10), scott, the teacher told him to change the first letter to an upper-case letter, and he did so, and wrote Scott. The teacher used instruction as a means of scaffolding (van de Pol et al., 2010; Tharp & Gallimore, 1988).

More often the teacher interacted more indirectly with John about the spelling of words, asking questions instead of making a comment directly. In lesson two, when John had written gardemuma for “kardemumma” (cardamom), he repeated the word silently, and the teacher asked him if he thought that the word sounded a bit strange. Then John started to try out various ways to spell the word and found the right one with double consonant at last (L2.1.22-26). When John in lesson thirteen wrote takk for “tack” (thank you), the teacher asked him: - Hur ska “tack” skrivas? (How is “thank you” spelt?), and John corrected the word (L13.1.18-21). The scaffolding means is questioning (van de Pol et al., 2010; Tharp & Gallimore, 1988).

The teacher made a special type of questioning in the cases when John wrote words with double vowel. John sometimes wrote two vowels when he had made a spelling mistake in a word with double consonant and was searching for the

right way to spell the word. John had written knufa for “knuffa” (push), and, according to the field notes, “he heard at once that something was wrong” (L23.1.4), and he changed the word to knuufa. Then the teacher made the question: - What kind of letter is /u/? and John answered: - A vowel. The teacher gave the rule: never two vowels, and John changed his word to the correct knuffa, but, according to the field notes, “he looked a little irritated” (L23.1.5-6).

The same type of questioning happened when John was writing about the space rocket “Sol raketten” (Sun Rocket), and he wrote the word “hette” (was called) incorrectly hete, tried to correct it and changed it to heete, with two vowels. The teacher asked what kind of letter <e> is, and she repeated her question. - A vowel, John said and corrected his word. - Never two vowels”, the teacher said, and John answered: - I ought to think of that (Det är det jag borde tänka på) (CD1John25epi11).

Questioning was the means of scaffolding in these cases, and the function of scaffolding was marking critical features, one of the functions which Wood et al. (1976) described. When John had written a word with double vowel, something that almost never occurs in Swedish spelling, the teacher’s questions directed his attention to the fact that the double letter was a vowel. The teacher reminded him of a rule which he seemed to know already: never two vowels. The critical feature was whether the double letter was a vowel or not.

Still another type of questions appeared, namely why-questions. In lesson sixteen John spelled the word “fortsatte” (went on) with only one “t”, fortsate, and auditory feedback was /fu:rtsa:te/. The teacher asked: “Varför säger den fortsate?” (Why does it say /fu:rtsa:te/?) John started to spell the word in different ways, and he ordered feedback with F1 every time when he changed the word, until he found out how to spell the word right (L16.1.23-28). In lesson twenty John wrote “foglar” instead of “fåglar” (birds), speech synthesis pronounced it like /fu:glar/, and the teacher asked: “Varför säger den foglar och inte fåglar?” (Why does it say /fu:glar/ and not /fo:glar/?). John did not answer the question, but he started to correct the word, and he managed to do that (L20.1.13-14).

The why-questions had the function of directing John’s attention to a critical point in a word and served as an incentive to find out the correct spelling of the word. The scaffolding function was recruitment to task, and the task was to work on a special trait of a word which had caused a problem with spelling. The traits were the same as often had caused problems: double consonant and confusion between <o> and <å>.

9.6.2 Domain contingency in scaffolding

There is sometimes a discrepancy between John’s activity and the comments the teacher made when she tried to scaffold his writing. In lesson six John was working on his story about a knight and a dragon (9.3.1). It was a vivid description of dramatic events. He made some mistakes in words with single and double consonant, and when he heard auditory feed-back he changed most words according to the norm (L6.1.8-28, 2.1-16). The teacher made a comment

in the field notes, but not about his exciting story or about his use of auditory feed-back to cope with the problems of double consonant. On the contrary, in the field notes, she wrote about his neglect to make a space after full stop: “John tar inte mellanslag efter punkt, och jag säger åt honom ett par gånger.” (L6.2.17) (John does not make a space after a full stop, and I tell him that a couple of times.) The comment was on a very small technical detail.

John was very eager to start to write about a rocket that went too near the sun in his story about the Fulmar rescue team (CD1JohnL25epi7). He rubbed his hands over the keyboard when he started writing and told the teacher that now she will get to know how a space-rocket went to the sun. The teacher did not respond to his interest in the content of the story, but she made a remark that the first letter should be an upper-case letter.

Then John wrote about the launching of the rocket and made a string of numbers for the countdown. When he made a full stop after the number string 10-0, speech synthesis read out the countdown. The teacher’s comment was that there was supposed to be a space after the full stop (CD1JohnL25epi15), a comment on a small technical detail.

In these examples, the teacher’s focus seemed to be on technical matters like space after full stop and upper-case letters, whereas John’s focus was on the content of his stories and on spelling of words. The appropriateness of teacher decisions about what to teach and what to focus on is called domain contingency in research on scaffolding, and it is deemed to be an important aspect (Rodgers, D’Agostino, Harmey, Kelly & Brownfield, 2016).

9.6.3 Repair as a type of scaffolding

Repair was best studied on the videotapes, which were lessons 12, 15 and 25. The videotapes from lessons 12 and 15 contained very few examples of repair, but the videotape from lesson 25 contained more examples (Table 10). The field notes did not always tell in detail how repair happened.

The type of self-initiated self-repair is the most frequent, with several examples in almost every lesson and already in the second lesson. John intended to write a dog’s name Ruff. He wrote ruf, and when he heard speech synthesis pronounce the name, he immediately inserted another <f>. He listened to ruff with F1 and said: - Nu! (Now!) (L2.1.28-29). He noticed the problem source by himself, and he could also take care of the problem by himself. Other types of repair organization, among them assisted self-repair, are also found in the material (table 8).

A repair organization of type other-initiation self-repair is found in lesson five. In the story about the knight and the terrible dragon the knight said: - Jag är på ett farligt stäle (- I am in a dangerous place). John noticed that he had no punctuation in the sentence, but he did not notice the missing double consonant in “stäle”. The teacher placed the cursor under the word stäle and ordered feed-back with F1. Now John noticed that there was a problem, he imitated feed-back and said /ste:le/, and he asked if he should remove <ä>. When the teacher said no, he suggested two <l> instead, and he changed his word to ställe, which is

correct (L5. 1.19-30). John made the repair after the teacher had initiated it and given some hints about what kind of changes were required in the word.

An example of self-initiation and other-repair is found in lesson 23, where John was writing the word “passagerare” (passengers), a word which is difficult to spell. He started with writing pash, then he ordered feed-back with F1 and erased <sh>. After that he wrote pasaserarna, and he erased the word after he had heard auditory feed-back. The teacher wrote the word “passagerare” on a scrap of paper, and John copied it on the keyboard (L23.1.12-15).

There are also examples where John noticed a spelling mistake when he heard auditory feed-back, and he needed help from the teacher to find the right way to spell the word. When he wrote hete for “hette” (was called) (CD1John25Epi11) and lykades for “lyckades” (succeeded) (L27.1.15-17), he noticed that there was a mistake and he tried various ways of spelling. When the teacher gave him advise, like “not two vowels”, and “<y> and not <u>”. he managed to spell the word. John made repair with assistance from the teacher, so the repair organization was self-initiated assisted self-repair.

Self-initiated self-repair was the most frequent repair organization, also in the early lessons. John sometimes made repair in a wrong direction, but then he listened to feedback again and made another repair, or the teacher helped him.

Table 10. *Repair organisation, Case 4*

Word, Sequence		Repair organisation	Lesson
Ruff	ruf – ruff	Self-initiated self-repair	2
Pappa (dad)	papa – papa	Self-initiated self-repair	2
Ställe (place)	ståle – ställe	Other-initiated self-repair	5
En gang (once)	engong – en gong	Self-initiated self-repair	15
Passagerarna (the passengers)	pash – pasaserarna	Self-initiated (wrong) self-repair	23
	pasaserarna – passagerarna	Self-initiated other-repair	
Hette (was called)	hete – heete	Self-initiated (wrong) self-repair	25
	heete – hette	self-initiated assisted self-repair	
Nytt (new)	nyt – nytt	Self-initiated self-repair	25
Från (from)	fron – från	Self-initiated self-repair	25
Rädda (rescue)	räda – rädda	Self-initiated self-repair	26
Skicka (send)	skika – skicka	Self-initiated self-repair	27
Lyckades (succeeded)	lykades – lukades	Self-initiated (wrong) self-repair	27
	lukades – luckades	Self-initiated (wrong) self-repair	
	luckades – lyckades	Self-initiated assisted self-repair	

The teacher sometimes corrected words after John had left the room. In lesson two there were three spelling mistakes in John's text (9.3) when the lesson ended. They were fron for "från" (from) with a confusion of <o> and <å>, tjöpa for "köpa" (buy) with a misspelling of /ç/, the "tje-sound", and gardemumma for "kardemumma" (cardamom) with a confusion of <g> and <k>. The teacher changed the spelling of all three words, so they were correctly spelt when John went on with his text in lesson three (L3.1.2). The teacher changed spelling mistakes also later, for example in lesson five when she changed en gong to "en gång" (once), and in lesson 22 when she changed stärm to "storm" (storm). These examples could be called other-initiated other-repair, if they are included in the scheme of repair organisation. The words which the teacher corrected were usually words with irregular or otherwise difficult spelling, i.e. words where auditory feed-back did not give any help with spelling. The teacher's corrections were more frequent in early lessons.

John reflected on his text in the following example of self-initiated self-repair of a sentence, a heading. He listened when speech synthesis pronounced the heading of his story: här är Stormfåglar mot solen (here are Fulmars towards the sun), and he commented that it could sound even better. He inserted a full stop after Stormfåglar (Fulmars), listened to speech synthesis again, and exclaimed: - Nå nu! (well, now!) (CD1JohnL25epi9).

9.6.4 Summarising reflections

Questioning is a means for scaffolding which appears often in this case, and there are various kinds of questions, also why-questions. A type of questions, which was used when John wrote double vowel, had the function of marking critical features. The other means of scaffolding which occurred often was instruction. Questioning gives more room for the child's thinking and for his or her own ideas than instructing.

Domain contingency in scaffolding was sometimes questionable. The teacher's interest was more in small technical details than in the content of the stories, for example, in a space after a full stop. The technical details that were in the teacher's focus in the examples are also important, but they are not supposed to be so dominating that they almost exclude other issues.

Self-initiated self-repair is the most frequent repair organisation. John made repair independently, and sometimes he made repair in the wrong direction and had to make another repair. With more difficult words, for example "lyckades" (succeeded), repair was assisted.

9.7 Summary of Case 4

John had no problem with writing stories about animals, rescue teams and space rockets, but he also wanted to have a break in his story-writing and to work with Ove training programs instead. He used the symbols of the keyboard in new ways, and he could find humorous points in rather dull training programs.

John often wrote a single consonant in words where double consonant is required, but he seldom made the opposite error, i.e. a double consonant in words where a single consonant is required. When he tried to correct a spelling mistake with a single consonant instead of a double consonant, he also tried impossible ways of spelling: double vowel and double consonant in front of a vowel. He did not usually try impossible spelling when he wrote a text. When John wrote double vowel, the teacher made questions which had the function of marking critical features, which means questions about what letters are vowels that cannot occur in a double version.

John learned to handle double consonant better during the project. He had less errors in the post-test. Six words which he spelt wrong in the early lessons appeared later, now correctly spelt.

Already in the early lessons, John sometimes used full stops and capital letters, but they were often omitted, unless the teacher reminded him. In the late lessons, John used a full stop and a capital letter in most cases where it was necessary. However, when he wrote with engagement, he sometimes failed to do punctuation and to use capital letters.

John used auditory feedback especially for correcting omitted letters and for correcting words with double consonant and words with confusion of <o> and <å>. He also used auditory feedback to make spaces between words and to make punctuation. He made comments about the quality of the synthetic speech.

The teacher used instructions and questioning with scaffolding functions, but the questions and instructions were sometimes directed to small technical details and not to the content of John's stories.

10 Comparison of Cases

The principal persons of the cases are not of the same age, which makes comparison more limited and more difficult. The two younger boys, six and seven years old at the beginning of the project period, and the two older boys, nine years old, can be compared to each other, but comparison between age groups is more difficult. The comparison in this chapter deals mainly with the development of the children's literacy skills.

Learning letters was a challenge for the youngest participant, Michael. He knew only a couple of letters when the project began. He learned many letters, but he also met some letters many times without learning them. In the post-test, he managed to sound out words, but he did not manage very well to write words, because he sometimes did not know what letter corresponded to the sound. Letter knowledge seemed to be the greatest obstacle for Michael on his way to acquire literacy skills.

The next youngest participant, Marc, knew almost all letters when the project began, but he had a period of three months when he did not manage to read words even if he knew all the letters. Blending the words seemed to be more difficult to Marc than learning the letters.

A challenging task for a young writer is perceiving a word as an entity in the constant flow of spoken language (Bodrova and Leong 2007). Michael dealt with well-known names as entities, but he had some difficulties with other words. When he wrote sentences in the last lesson, he several times wanted to move on to the next word after having written only one letter in a word. He seemed to think that he had finished the word when he had written a letter. He did not learn to make a space after a word independently during the study (6.3.3). Marc needed a little help from the teacher in the first lessons for using spaces after the words. Gradually he learnt to use the space bar independently, even when he wrote sentences. He distinguished the words as entities also in their context in a sentence (7.3.1).

The directionality of print (Riley & Reedy, 2000) from the left to the right, was another challenge. Michael often started to sound out from the end of the word, until the teacher managed to turn his attention to the beginning (6.3.1), and Marc also sometimes started sounding out with the last sound. When they tried to read words and they did not yet know how to do it, they began with pronouncing the letters, and then the last letters were most recently pronounced when they started to try to read the word. Michael sometimes even in late lessons tried to start reading from the right, and Marc did the same thing, but only in the first five lessons (7.3.2).

A tendency in two opposite directions was found in the two younger children's attempts to spell words. Both Michael and Marc often suggested a vowel for the first sound in a word, despite there were other sounds before the vowel. Marc sometimes did the opposite, when he omitted the vowel totally, for

example when he wrote stl for “stol” (chair) and rt as his first attempt of “raket” (firework) (7.3.3).

Double consonant is a difficult issue in Swedish, and the two older children, Chris and John, worked with the problem in different ways. Chris had a period of overuse of double consonant, and John sometimes wrote words with impossible spelling when he tried to correct errors. They both sometimes wrote words, in which double consonant was required, correctly with double consonant and sometimes with a single consonant. They used auditory feed-back to find the right spelling of the words, and they corrected most words which required double consonant, but not all.

Chris spelt words with double consonant correctly more often, but he left more words uncorrected. He wrote double consonant in words where it was not required. He had a period in the middle of the project, from lesson thirteen to lesson twenty, when he wrote unnecessary double consonant in many words (Table 6). In the early lessons he had only two words with unnecessary double consonant and after lesson twenty he had none. Between lessons thirteen and twenty, he had a couple of unnecessary double consonant in almost every lesson, apparently a kind of overuse during a period (Nauclér 1989).

John often wrote a single consonant in words where double consonant was required (Table 7, chapter 9). When he heard auditory feedback, he usually noticed that there was a spelling mistake in the word, and he worked hard to correct it. He sometimes tried impossible spellings when he tried to correct a word, for example double consonant before the vowel or even two vowels. He usually managed to correct his impossible spellings using auditory feedback. He managed to correct almost all words where double consonant was needed, except some words with <n> which have special rules. The impossible spellings almost always occurred when he in various ways tried to find the correct spelling of a word with double consonant. Only one or two examples can be found, when he spelt in an impossible way with double vowel or double consonant before a vowel, and he was not correcting a misspelt word.

Marc, seven years old, sometimes wrote words where double consonant was required, and the teacher almost always instructed him to make double consonant. Even when he wrote relatively simple words in which he knew all letters, for example the name Hasse, the teacher told him to write two consonants.

When the children began to write sentences, the use of punctuation and capital letters became important. The two younger children depended on the teacher for the use of punctuation and capital letters. Michael did not even seem to know what a full stop looked like. Marc seemed to have some understanding of the use of a full stop, but he also depended much on the teacher (6.4, 7.4.).

Chris and John used full stops already in the first lessons, but sometimes they failed to use them. The teacher reminded Chris of full stop, but sometimes in the wrong places. In the later lessons both Chris and John managed rather well to use full stops, and then they also used exclamation marks and commas. John had dialogue in his texts, and he used a hyphen to begin utterances.

Chris apparently had difficulties in understanding the teacher's instruction about "capital letter at the beginning of a sentence". In one story he used capital letters to begin the lines and not the sentences. Even the rule "capital letter after a full stop" was not quite easy to understand for Chris. He, a couple of times, applied the rule by beginning a sentence with a full stop. John had no difficulties of that kind, and he usually used capital letters in a proper way especially in the later lessons. A special difficulty both for Chris and John was to remember to make a space after a comma or after a full stop (chapters 8.4, 9.4).

11 Discussion

The overarching aim of the study is to increase knowledge of literacy skills when writing is scaffolded by auditory feedback from speech synthesis. The specific aim of the study is twofold: to follow literacy learning during a period of text-writing with auditory feedback from speech synthesis, and to study the process of scaffolding, which means how children use auditory feedback as a scaffold for their writing and how the teacher scaffolds the children's work.

The study is about a teaching project, in which four children used a text processing program with auditory feedback from speech synthesis as a scaffold for their text-writing. The material was mainly collected through participant observation, which means that the researcher acted as the teacher in the project. The teacher interacted with the children on a one-to-one basis during their writing. She tried to scaffold their writing according to the traditional concept of scaffolding (Wood et al, 1976: Bruner, 1986: Stone, 1998), with the aim to enhance their literacy skills.

11.1 Scaffolding Writing

In this chapter, I will discuss how the scaffolding of the children's writing progressed. The starting point of the discussion is the core characteristics of scaffolding which several researchers (Masters & Yelland 2002; van de Pol et al., 2009; Stone, 1998: Yelland & Masters, 2007) have found. The characteristics are the following: a joint task engagement, a contingent support that varies according to the competence of the child and a transfer of responsibility from adult to child. After that, the functions (Wood et al., 1976) and the means (Tharp & Gallimore, 1988) of scaffolding writing in the cases will be discussed, and finally the concept repair (Martin, 2004; Schegloff, Jefferson & Sacks, 1977) as a description of the organisation of corrections will be discussed.

A joint task engagement means that both the child and the adult are actively working towards a common goal in a collaborative way and that the learner's own intentions are the aim of the process (Masters & Yelland, 2002; Stone, 1998). This kind of joint engagement is found in many examples in the cases. The children decided what words and what text they intended write. The fact that the texts were self-generated gave the children an interest in expressing them in print and created a joint task engagement between child and teacher. It was sometimes difficult for the younger children, Michael and Marc, and for Chris also, to find something to write about. On these occasions, the teacher and the child talked about hobbies and experiences, and usually the children found an interesting theme for their writing. Sometimes the children, especially the younger ones, lost their interest and seemed exhausted by writing. In these cases, the program was changed to games or to word cards, and after a break, sometimes for several lessons, writing could start again. All the children were

interested in the computer and especially in the function of the speech synthesis, which the teacher/researcher also was interested in. The shared interest between the teacher and the children helped them to find a joint engagement in writing.

The actions of the teacher usually promoted a joint task engagement, but this was not always the case. Sometimes the teacher wrote field notes and was not very present in the situation. When Michael struggled with the sound /u/ in the words “hos” (at) and “mommo” (granny), and tried to find the corresponding letter, the teacher was writing field notes and did not give full attention to his work. The teacher did not pronounce the sound, she only pointed to <O> on the keyboard. Michael did not learn the letter <O> in that lesson despite writing it several times, and the teacher’s inattentiveness very probably contributed to that result (6.2.3).

There are also examples of situations when the teacher’s engagement was in other parts of the task than the children’s engagement. The older children, John and Chris, wrote vivid descriptions of spaceflights and animals, and thus, they focused on the content of their stories, while the teacher focused on formal spelling details. When John wrote a story full of action about a knight and a dragon, the teacher’s comment was: - Make a space after a full stop! When he wrote about a space rocket that went to the sun, the teacher’s comment was about the need of an upper-case letter, and the teacher even interrupted his writing for a training program with double consonant. However, John went on writing his story the next lesson and finished it the following lesson (9.6.2).

Chris asked about the continuation of a nursery rhyme which he had written, and the teacher did not answer his question but began to talk about a full stop after the sentence. When Chris had completed his sentence with a full stop, the teacher suggested that he should continue the rhyme, but Chris did not want to go on writing the rhyme any longer. The teacher did not answer the question when he made it, and later he was not interested.

In these cases, the teacher’s focus was on formal details in writing, and the children’s focus was on the content of the story. There was a joint task engagement between the teacher and the children in the text which the children wrote, but the engagement was sometimes in different aspects of the task. The teacher seemed to be very engaged in formal aspects of writing and not so much in the content.

Another core characteristic of scaffolding is a graduated assistance which varies according to the competence of the child, or, in other words, a contingent support which means that the support is adapted and adjusted to the competence of the learner and to the task (van de Pol et al. 2010; Stone, 1998). With Vygotsky’s concept, this means that the support is given in the zone of proximal development where learning best can occur. A contingent support demands that the teacher has knowledge of the competence of the children, either by diagnostic testing or by observing the children’s writing, which is best done individually (Hoschbaum, Peters & Sylva, 1996; Rodgers, 2004).

To find the right amount of support, not to help too much nor too little, was a constant dilemma for the teacher. There are examples of both too much and too little support in all the cases. When the teacher gave too much support, the children lost the opportunity to listen to auditory feedback and to make a judgement of the letter or the word they had written. An example of too much support is when the teacher did not let Marc discover the need of double consonant in a simple word, e.g. the name Hasse, but said “Put another s”, before Marc had time to try out his writing (7.3.3). Another example of too much help was when the teacher reminded Chris of making full stops in his story about the tree and the woodman. The problem was that the teacher made the suggestions for full stop before Chris had finished his sentences, and the full stops were placed within sentences.

When the teacher gave too little support, the children, especially the younger ones, could lose their interest and their courage to write. To write a word took a disproportionately long time in those cases when the teacher helped too little, for example when it took three and a half minutes for Marc to write the word “hade” (had) (7.6.2). In most cases, however, the teacher seemed to manage to give a relatively proper amount of support. The teacher had knowledge of the children’s reading and writing skills from the diagnostic tests, which were made before the lessons began, and the teacher could observe the children individually, because the lessons were held on a one-to-one basis. This knowledge helped the teacher to give approximately the right amount of support.

The third core characteristic is that scaffolding is gradually withdrawn, faded away, when the learner does not need it any longer, and the responsibility is transferred from the teacher to the learner (van de Pol et al, 2010; Stone, 1998). With the two younger writers, the teacher was very active during the early lessons, modelling sounds and pointing to letters. With Marc, the teacher withdrew considerably after some lessons, and Marc wrote single, simple words independently using auditory feedback. The teacher tried to withdraw also with Michael, the youngest child, and let him write parts of words independently, but Michael was not always ready for that. When the children wrote more difficult words or whole sentences, the teacher was more active again, which can be compared to the study of Hoschbaum et al.(1996), where scaffolding was not withdrawn but changed to happen on a higher level if the task developed to a higher level of difficulty, such as writing of self-generated texts during a period.

The two older children wrote more independently already in the first lesson, and in the late lessons the teacher had withdrawn to a great extent. For Chris, there is a notation in the field notes for one of the last lessons that the teacher did not intrude into his writing, and the video from the last lesson also shows that the teacher only answered questions and did not intrude (8.6.1). Sometimes withdrawing happened too early, for example in the example above, when Marc was mainly left alone working with the word “hade” (had). Another example is when the teacher had explained to Chris about capital letters and then withdrew

to write field notes. Chris made a capital letter in the beginning of every line in his story, regardless of borders between sentences.

The three core characteristics which many researchers (Masters & Yelland, 2002; van de Pol et al., 2010; Stone, 1998; Yelland & Masters, 2007) have found in scaffolding are also found in the scaffolding of writing in this study, even if there are some problems.

The difference in focus on the task, which appeared more with the older children, is a problem. The children wrote stories with great interest, but the teacher seemed to be more interested in formal details, for example capital letters and full stop. Using Hagtvet's (2009) formulation that writing consists of encoding and of conveying a message, the teacher focused mostly on the encoding part of the formula in these examples.

The fact that the teacher reminded John and Chris to use punctuation marks, spaces and capital letters was quite adequate, because they were learning to use these characters, and learning them was in their zone of proximal development. The problem was only that the teacher could have paid more attention to the content of their stories. Domain contingency, which means that scaffolding is directed to an appropriate goal, is found to be a very important aspect of scaffolding (Rogers, D'Agostino, Harmey, Kelly & Brownfield, 2016), and it was insufficient in these examples.

These problems with the teacher attending to formal details in the text and not to the content of stories was noticed in the videos and not in the field notes. Another problem was noticed in the field notes: the teacher sometimes wrote about the children in a negative way and exaggerated their difficulties. This happened most clearly with Chris (8.6.2), but also to some extent with John (9.2.4). A joint task engagement is one of the core characteristics of scaffolding, and central to this image are notions of affective engagement, intersubjectivity and shared understanding (Stone 1998). The negative notations in the field notes make the teacher's affective engagement a little questionable, even if there are no signs of negative behaviour in the videos, and the cooperation between teacher and child seems to be good.

It can be easier for a teacher to notice difficulties and problems in the behaviour of a child than to notice strengths and achievements, because of the function of human attention. A possible danger or threat arouses attention, and an ambiguous situation is more often interpreted in a threatening rather than an innocuous fashion (Eysenck & Keane, 2000, p 505), which makes it easier to notice a negative behaviour than a positive one.

The scaffolding functions which were found in the cases in this study were recruiting to task, simplifying the task, direction maintenance, marking critical features, frustration control and modelling (6.6.1, 7.6, 8.7.1, 9.6.1). They were the same scaffolding functions which Wood, Bruner and Ross (1976) found in their research. Modelling was more frequent with the younger children, especially modelling of sounds.

Following means of scaffolding were found: instruction, questioning and feeding-back (6.6.1, 7.6.1, 8.7.1, 9.6.1). Instructions were often reformulated as

questions in later lessons, as Tharp and Gallimore's (1988, p 56) remarked that effective instructions must be embedded in a context of other effective means. The teacher's instructions sometimes met a negative reaction (8.6.1). Some questions had the scaffolding functions of recruitment to task and direction maintenance. Instruction, questioning and feeding-back were all among the means of assisting performance which Tharp and Gallimore (1988) found. Feeding-back, which is the crucial idea in this study in the shape of auditory feedback from speech synthesis, is according to Tharp and Gallimore (1988, p 54) a powerful means of assisting performance.

When the children wrote words and texts with auditory feedback, they often had to correct their work when the result did not correspond to the word they had intended to write. The corrections were analysed according to the theories about repair (Martin, 2004, 2009; Schegloff, Jefferson & Sacks, 1977). Repair is used when there is a problem in communication, or the speaker or, in this case, the writer, is not satisfied with his utterance or text.

All the variations of repair organisation from other-initiated other-repair to self-initiated self-repair were found in the cases. Assisted self-repair was a type of repair that often occurred, which usually happens in interaction between child and adult and especially in teaching.

There were some examples of a sequence of repair in a word or an expression where a development was found from other-initiation to self-initiation and other examples with a development from assisted self-repair to self-repair. A tendency to more independence in later lessons was also found. The development from other-initiation to self-initiation is important, because it means that the child can decide by himself with the help of auditory feedback if the word is correct or not. The development from assisted self-repair to self-repair is also important, as a development to more independent work with words. According to Martin (2004), changes in repair organisation are related to learning.

In this study the development of repair could best be studied within a sequence of a word or an expression. Clear examples of development over time of a repair organisation as a change in the specified "same" practise of repair in relation to a specified "same" learning object (Martin, 2004, p180) were difficult to find in my material. There were not so many video recordings in the material where small changes in repair organisation could be studied, and the field notes did not very often give clear descriptions of repair organisation.

A figure borrowed from the theory of activity theory (Hayes, 2006; Postholm, 2015; Russell & Yanes, 2003) can throw light on the process of scaffolding (Figure 5). The child subject and the teacher subject work together with shared tools in the environment of a community with rules and with division of labour. The child subject and the teacher subject also share the goal, which, in a school context, is learning. Besides the shared goal, the child and the teacher also have other goals, and they are also members in other activity systems. The child is a member of a group of schoolmates, with whom he may share interest in computer games, and the teacher is a member of a group of PhD students. The

goals of the child subject and of the teacher subject can sometimes differ from each other.

Joint task engagement and shared interests is one of the core characteristics of scaffolding which were discussed at the beginning of this chapter. Problems appeared in joint engagement when the teacher was more interested in formal aspects of writing and the children were more interested in the content of their stories, for example in remembering rhymes and in writing about dragons and spaceflights. There was a difference, maybe even a contradiction, between the teacher’s and the children’s goals. Differences and especially contradictions in goals can lead to conflicts, but conflicts can also bring change and development to a higher level, according to activity theory (Hayes, 2006; Postholm, 2015; Russell & Yanes, 2003). The teacher’s notations in the field notes, which with a negative flavour exaggerated the difficulties of a child, might indicate the existence of a conflict. In this case, the teacher could have developed a greater awareness of the differences in goals and a greater interest for the content of the children’s stories.

An important outcome of activity in a school system is, naturally, learning. Next chapter will discuss how the children’s literacy skills developed during the period of scaffolded writing.

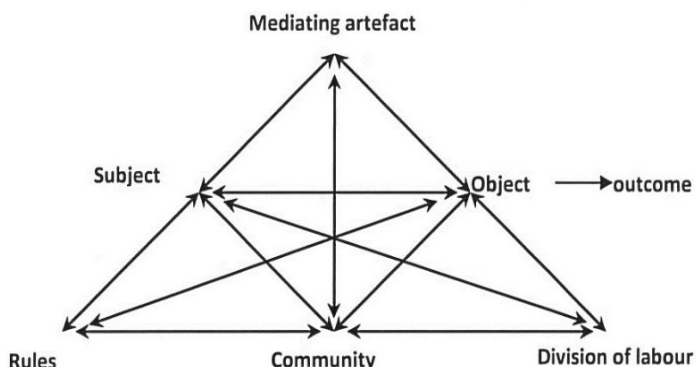


Figure 5. *Scaffolded writing in an activity system*

11.2 Development of Literacy Skills

The aim of my study was, besides to study the process of scaffolding, to follow literacy learning during a period of text-writing with auditory feed-back. With a case study, it was possible to describe in detail how the development of literacy skills of each of the children happened. Two of the participating children, Michael and Marc, the youngest ones, were at the beginning of their acquisition of reading and writing, and two children, Chris and John, had already acquired the basic

skills. The two youngest children still had much work to do on the transcription part of writing (Berninger & Winn, 2006), that means handwriting, keyboarding and spelling.

11.2.1 Making connections between phonemes and graphemes

A distinguishing trait in writing with auditory feedback is that the letters and their sounds are presented in a functional context. The children search for letters to the sounds in words which they themselves have chosen to write. Letter learning was topical for the youngest child, Michael, and to some degree also for the next youngest child, Marc. They had many opportunities to make the connection between a phoneme and a grapheme during the lessons. They often heard the teacher pronounce the phoneme, they pronounced it themselves and they heard speech synthesis pronounce it. They had to look for the letter, the grapheme, on the keyboard, they saw it on the screen at the same time as they heard the sound, and later they saw it on the out-print.

Michael knew only a few letters when the lessons began, and he knew many letters when they ended, so learning occurred during the project period. In the examples where learning of the letters <R> and <E> can be followed, the teacher used both the scaffolding functions of modelling and simplifying the task. In the case of the letter <O>, when learning did not occur although Michael met the letter many times during the same lesson, the teacher did not model the phoneme, only simplified the task by pointing to the letter and, after that, withdrew to note-taking. In these cases, the teacher's proper use of scaffolding functions seemed to be important for making it possible for Michael to connect phoneme and grapheme.

Learning the connection between phonemes and graphemes is not an easy task for all children (Piasta & Wagner, 2011). The frequent exposure of a speech sound together with the corresponding letter is estimated to be useful for struggling readers and writers, because many children with risk for reading and writing difficulties have problems with sound discrimination at an early age (Lyytinen et al, 2009). Other ways of presenting phonemes and their corresponding graphemes with digital equipment have been tried out, for example *GraphoGame*, with good experiences, and a Swedish version, *Spelett*, published in 2009 (Saine, Lerkkanen, Ahonen, Tolvanen, & Lyytinen, 2011; Spec-Nytt, 2009;).

In writing with auditory feedback, the children met the letters and their sounds in a functional context, when they searched for letters to the sounds in words which they had chosen to write. Learning letters in a functional context can be useful for the development of understanding of the character of written language and for the development of text comprehension (Hagtvet, 2009).

11.2.2 Word reading and writing

Letter knowledge was not always enough for reading. Marc had a period of almost three months, the ten first lessons, when he knew letters, but he did not manage to read words. According to the assessment report, he had a low level of

phonological awareness, especially in segmenting and synthesizing, when the project began. He could pronounce the sounds of all letters in a word without being able to read the word (7.3). This is in accordance with the findings of Piasta and Wagner (2011), that even if letter knowledge is one of the most important prerequisites for reading (Scarborough, 1998, Hammill, 2005), pure name and sound knowledge of letters is not enough, but practice and instruction in using alphabetic knowledge for reading, e.g. blending, are also necessary (Piasta & Wagner, 2011, p 27). Marc began to succeed in reading short words in lesson thirteen, when he had begun to write small sentences and not only single words. Something had apparently happened in his development of literacy skills between lesson ten and lesson thirteen which made him able both to read words and to write sentences.

Reading and writing of words were tasks with many challenges for the two younger children. They had to perceive a word as an entity in the constant flow of spoken language, a task which according to Bodrova and Leong (2007) is the most critical aspect at this stage in the development of writing. The youngest participant worked hard with the concept of a word in the last lesson, and the next youngest one learned after some practising to use the space bar after a word. Speech synthesis automatically after some practising pronounced the word when the writer pressed space. Hearing the word pronounced was a nice experience, which often made the writers smile or make a comment, and which probably helped them to understand the concept of a word.

The directionality of print (Riley & Reedy, 2000) from the left to the right, was another challenge. The two younger children usually first pronounced the word which they were going to write and then they began to sound out the phonemes. The function of memory, the recency effect (Eysenck & Keane, 2000), can explain why they sometimes began reading and writing from the end of the word. They had the last letter or the last sound in the freshest memory, and a tendency to reversal need not necessarily be the explanation.

The two younger children both sometimes suggested an intermediate vowel for the first sound in a word, and Marc sometimes totally omitted the vowel, which means a tendency in two opposite directions. The explanation can be a trait in the perception of words which can work in different directions (Lindell, 2006). A vowel can be easier to detect in speech than a consonant, but the first and the last speech sounds in a syllable or a word are easier to recognize than the speech sounds in the middle of a syllable (Lindell, 2006; Read, 2009, p 262).

Both Michael and Marc sometimes suggested a vowel too early, and when they had found the preceding letters, they had difficulties in finding the vowel again (6.3.1, 7.3.3). It is not easy to understand why it was so difficult to find the vowel again, the vowel which they had suggested a few minutes, or even a few seconds, ago. The explanation could be that they experienced a failure when they first suggested the vowel, and after that they were not very willing to suggest the same vowel again. It would be important to arrange the work with writing so that experience of failure can be avoided.

11.2.3 Double consonant

Double consonant is deemed to be the most difficult part of Swedish spelling (Wengelin, 2013b). Words with double consonant are frequent, and the rules are complicated with many exceptions. It has been estimated that about half of all school-children's spelling mistakes concern the problem of double consonant (Elbro, 2004, p 70). The two older children, Chris and John, wrote many words where double consonant was necessary.

Chris had a period when he wrote double consonant in words where double consonant was not required. According to Nauc ler (1989), it is a kind of overuse when some children write double consonant in words where it is not correct. The children have become aware of the need of double consonant in some words, but they do not yet know how to use their knowledge. Nauc ler (1989) explained it as a stage in the development and a step forward. For Chris, it is possible that his period with unnecessary double consonant was just that, because he had no mistakes of that kind in the last lessons.

John had very few examples of double consonant in wrong places, but he had more examples of single consonant when double consonant was required. He had also some examples of impossible spellings, for example double consonant in front of a vowel and double vowel. He made the impossible spellings when he tried to correct a misspelt word and very seldom otherwise.

Chris and John worked in different ways with the problems of double consonant. Both Chris and John seemed to learn about double consonant during the project. Some words which were misspelt in the early lessons appeared correctly spelt in later lessons, and their results in the post-test were remarkably better than in the pre-test concerning double consonant. They both often used auditory feedback to correct words with misspelt double consonant. They had many opportunities for error self-correction, which was identified in a research review as the most critical contributing element to spelling achievement (McLaughlin, Weber & Derby, 2013). The fact that Chris and John corrected their words immediately when they had written them was probably favourable for their learning to spell words with double consonant, because the same research review showed that immediate self-correction was more effective than self-correction which happened later (McLaughlin, Weber & Derby, 2013).

Marc, seven years old, also wrote some words with double consonant, but the teacher almost always instructed him, so he had no possibility to learn about double consonant by trying it out himself.

11.2.4 Punctuation and capital letters

Punctuation became necessary as soon as the children began to write sentences. The character of the Ove program stimulated the use of punctuation, because a punctuation mark automatically produced auditory feedback by speech synthesis of the preceding text, usually a sentence. Punctuation, capital letters and spaces between words are distinctive properties of written language and not

present in spoken language, so it is quite natural that it can take a long time for a young learner to master it (Hall, 2009).

Michael, the youngest participant, did not seem to be quite sure of the look of the full stop (chapter 6.4). According to Hall (2009, p 274), it is not surprising that a young writer fails to pay attention to a full stop, because the visual appearance of it is tiny, almost invisible.

Chris and John used full stops already in the first lessons, but sometimes they failed to use them. Spelling and writing mean a substantial cognitive burden for a young writer, which can have the consequence that punctuation does not get enough attention (Hall, 2009). The teacher tried to remind them, but in the first lessons she suggested a full stop to Chris when he had not yet finished the sentence.

The concept of sentence can be difficult to understand for a young writer. Chris understood “a sentence” as “a line”, when he applied the rule “capital letter at the beginning of a sentence” by making a capital letter at the beginning of almost every line. The children in Hall’s (2009) study had the same kind of difficulties, when they used end-of-line and not end-of-sentence punctuation.

11.2.5 Variability in writing

There is considerable variability in the use of punctuation and capital letters. Other examples of variability of responses can also be found, for example in letter knowledge and in spelling of double consonant. The youngest child sometimes found the letter he was looking for, and on other occasions he did not find the same letter (Table 2). The two older children could spell a word with double consonant correctly and fail to write double consonant in another word of the same type (Table 6, Table 7).

The variability in my material can be compared to Martin’s findings of variability (2009, 2004) in her study of learning in physiotherapy. There were changes back and forth in the responsibility and control of error identification and corrections. Her explanation was that “learning is a stepwise and gradual, but not a straightforward, linear process” (Martin, 2009, p 146).

According to Ehri (1997, p 261), it is not surprising to find inconsistency in children’s writing, because spelling is unstable among novices.

11.2.6 Willingness to write

To find willingness to write was sometimes difficult, especially for the younger children, but sometimes also for the older ones. Michael declared in the first lesson that he did not know how to write, and Marc sometimes only wanted to write strings of random letters. Sense of competence in writing, self-efficacy, is an important basis for willingness to engage in writing (Bandura, 1997; Boscolo, 2009; Hidi & Boscolo, 2006). When Marc exclaimed at the end of a lesson that he had written eight words today, he was building a sense of competence in writing, and it did not take long until he began to write sentences.

Another circumstance which can influence the attitude to writing in a positive way is interest, created by the topic or by attractive features of the organisation of writing which emerge in a special situation (Boscolo, 2009; Hidi & Boscolo, 2006). The traits in the organisation of writing which inspired the children in this study were the use of a computer and the feedback from speech synthesis, and the collaboration with the teacher (chapters 6.1, 7.1, 8.1,9.1) .

When the children found an interesting topic, they were eager to write, and sometimes they even did not want to stop when it was time for a break. Michael made a little story about a trip to Helsinki, and with help from the teacher he managed to write it. Marc wrote a story about a football match, and he began his story the week before the match and finished his story with the results of the match. Chris wrote more facts than fiction: a list of his videogames, a description of pets and instructions for taking care of them, a sequence of numbers and letters. John retold stories which were full of action and had a narrative superstructure (Alamargot & Fayol, 2009). The children also wrote other types of texts than narratives in temporal order about their own experiences, which is the most frequent type of stories that young children write (Alamargot & Fayol, 2009). The children had themselves chosen the topics, a fact which probably made the topics more inspiring.

11.3 The Use of Auditory Feedback

To study the scaffolding process and to follow literacy learning during the period was the aim of my study, and the scaffolding process means both how the teacher scaffolded the children's writing, and how the children used auditory feedback from speech synthesis as a scaffold for their writing.

Feeding-back information on performance is one of the main assisting means according to Tharp and Gallimore (1988). Speech synthesis in the Ove program gives auditory feedback on letters, words, sentences and paragraphs which are written. Besides that, a writer can order feedback with an F-key, also on a part of a word.

For information to be considered feedback it must be fed to a system which has a standard for performance and a mechanism for comparing performance to the standard (Tharp & Gallimore, 1988). The standard for performance of word-writing was that the word pronounced by speech synthesis was reasonably similar to the intended word pronounced in normal speech. The young writer and the teacher collaborated in comparing performance to the standard.

The younger children used auditory feedback to explore letters and their sounds and to follow and check their spelling of short words, during the process of writing. They soon learned to order and to use feedback independently, Michael in lesson five and Marc at least in lesson six. The use of auditory feedback is a kind of self-regulation, which according to Berninger and her co-workers is an important part of developing literacy (Berninger & Amtmann, 2003; Berninger & Winn, 2006).

Michael used the keyboard and auditory feedback to search for the letters he needed. The teacher sometimes showed him in which row of keys he could find the letter, so he had a smaller area to search. He saw the symbol of the letter and heard its sound when he pressed the key, and he learned many letters during the study. He usually managed to find the letter he needed, sometimes with a little help from the teacher, but it was apparently not so easy for him. The fieldnotes mention a couple of times that he lost his interest when he did not find the letter he was looking for or when he confused letters (6.5).

Michael and Marc spelled words using auditory feedback for the growing word for every letter they wrote, and they could check how the word developed in that way (7.5). The older children, Chris and John, used auditory feedback to check words and sentences after they had written them, and they used feedback in different ways. Chris used feedback which came automatically after a word and he used F6 to hear the whole text, but he did not until in the last lessons use F1 very much to study single words. He even showed signs of frustration and pressed many keys at the same time when the teacher encouraged him to use F1 (8.6.1). John was more eager to use F1 to study single words, and he also used feedback to check text structure (9.5.3).

Auditory feedback was effective for detecting and correcting mistakes in words with double consonant, in those cases where it was possible to hear from the pronunciation of the word if a double consonant was necessary. Auditory feedback also served well for detecting and correcting confusion of letters, in those cases where it was possible to hear the confusion when the word was pronounced.

Auditory feedback gave the children a chance to correct errors immediately. In a research review, error self-correction was identified as the most critical contributing element to spelling achievement, and immediate self-correction was more effective than self-correction which happened later (McLaughlin, Weber & Derby, 2013). Berninger and her co-workers (Berninger & Amtmann, 2003; Berninger & Winn, 2006) mentioned strategies for self-regulation as an important part of developing writing. The use of auditory feedback can be a means of developing self-regulation of writing.

The children used auditory feedback for the kind of spelling which they were learning for the moment. Michael used auditory feedback to find the letters he needed, Marc used auditory feedback to check the words he wrote, and Chris and John used it to check words with double consonant. Especially John used auditory feedback to check text structure, which means punctuation and spaces between words.

The children also used auditory feedback to create new words and to play with words and symbols. The younger children made new words of the sounds they were pronouncing when they were writing a word. Even if they did not know how to read words, they could make up new words from sounds they heard during writing (6.1.2, 7.1.2). The older children were amused by investigating how speech synthesis pronounced the symbols on the keyboard, and they even used symbols as words, especially names, in their stories. They made word

riddles and amused themselves by making speech synthesis read their text with high speed (8.1.2, 9.1.2).

11.4 Pedagogical Implications

The experiences from my study show that writing with auditory feedback from speech synthesis can be used for training writing and reading skills as a variation and as a part of other methods for literacy learning. The use of auditory feedback helped the children to find willingness to write, which often can be difficult for a struggling reader and writer.

Writing names and simple words with auditory feedback can be a way of learning letters in a functional context for a child in a pre-school class and in the first school year. Knowledge of letters is a crucial prerequisite for reading and writing, but researchers (Piasta & Wagner, 2011) have found that letter training, although it is effective, is not as effective as could be expected. It is not so easy for a struggling reader and writer to make the connection between phoneme and grapheme. There is a need for various types of letter training and especially for letter training in a functional context, which means that the letters are used to make words (Hagtvet, 2009).

Using letter names in writing of words can create confusion, which occasionally happened to both Michael and Marc. However, letter names usually give a clue to letter sounds, and the use of both letter names and letter sound have turned out to benefit letter learning (Piasta, Purpura, & Wagner, 2010).

The use of double consonant is the most difficult part of spelling in Swedish (Wengelin, 2013b). Auditory feedback can be used to explore the use of double consonant, as Chris and John did. The two boys developed their knowledge of double consonant in their own way, and they also used auditory feedback in their own way,

My study showed an example of the importance for a young learner to avoid an experience of failure. I was puzzled by the fact that both the younger children had difficulties in finding a speech sound a second time when they had made a mistake by suggesting the actual sound too early in a word. My explanation is that the experience of failure they had when they first suggested the sound made them unwilling to suggest the same sound again. This problem could have been avoided if the teacher had made a dotted line for the word (Bodrova & Leong, 2007 b) and written the letter for the suggested sound in its correct position. The children had then been able to go on working with the word without experiencing a failure. It is very likely that experience of failure also in other circumstances can make a young learner reluctant to try again.

11.5 Strengths and Limitations

Multiple sources of evidence are used in my study, which, according to Yin (2014, p 119), is a major strength of case study data collection. Participant observation

is an important source of evidence in my study, which gave a possibility to study the teaching project from within. Participant observation also involves major challenges (Yin, 1994, 2009, 2014), and one of the challenges is that the participant role and the observer role both require too much attention and too much time. In my study, when the researcher wrote field notes and acted as a teacher at the same time, she was sometimes writing field notes when the pupil needed assistance (chapter 6.2.3). On the other hand, it was often difficult to find the time to write field notes during the lessons.

Documentation on video gave a more thorough picture of what happened during the lessons. The field notes showed what the teacher thought, and the videos showed what really happened. There were only two videotaped lessons from every case and only one from the first case, which was too little. All lessons should have been videotaped.

There was also documentation as a log of keystrokes from all the lessons, which was of great help for completing the field notes. The log was also of help for transcribing the videotapes, because the log showed what key had been pressed, which means what letter had been used. The different sources of evidence supported each other, and they gave an elaborated picture of the development of literacy skills and of scaffolding in the cases.

The leading characters in the four cases were of various ages and on various stages in their literacy development. It was interesting to follow their development of literacy skills from learning of letters to reading and writing words and to writing sentences and spelling more difficult words. However, it had been better if the four participating children had been of the same age and in the same grade. In that case, it had been possible to compare the cases more and to see if the same tendencies appeared in all four cases or only in a single case.

References

- Abbott, C. (2007). *E-inclusion: Learning difficulties and digital technologies*. Report 15. Futurelab series. King's College, London.
- Agélii Genlott, A. & Grönlund, Å. (2013). Improving literacy skills through learning reading by writing: The iWTR method presented and tested. *Computers & Education*, 67, 98-104.
- Alamargot, D. & Fayol, M. (2009). Modelling the development of written composition. In: R. Beard, D. Myhill, J. Riley, & M. Nystrand (Eds.). *The Sage Handbook of Writing Development* (pp 23-47). London: Sage.
- Allen, J., Hunnicutt, M. S., Klatt, D. (1987). *From Text to Speech. The MITalk system*. Cambridge University Press.
- Archer, K., Savage, R., Sanghera-Sidhu, S., Wood, E., Gottardo, A., & Chen, V. (2014). Examining the effectiveness of technology use in classrooms. A tertiary meta-analysis. *Computers & Education*, 78, 140-149.
- Aro, M., & Wimmer, H. (2003). Learning to read: English in comparison to six more regular orthographies. *Applied Psycholinguistics*, 24(4), 621-635.
- Bereiter, C. & Scardamalia, M. (1987). *The psychology of written composition*. Hillsdale, New Jersey: Lawrence Erlbaum Associates.
- Bereiter, C. & Scardamalia, M. (1993). Composing and writing. In: R. Beard, (Ed), *Teaching literacy, balancing perspectives*.
- Berninger, V. W. (2009). Highlights on Programmatic, Interdisciplinary Research on Writing. *Learning Disabilities Research & Practice* 24(2) 69-80.
- Berninger, V. W., & Abbott, R.D. (2010). Listening comprehension, oral expression, reading comprehension, and written expression: related yet unique language systems in grades 1,3,5, and 7. *Journal of Educational Psychology*, 102(3) 635-651.
- Berninger, V.W., & Amtmann, D. (2003). Preventing written expression disabilities through early and continuing assessment and intervention for handwriting and/or spelling problems. Research into practice. In: H.L. Swanson, K. Harris, & S. Graham (Eds.), *Handbook of learning disabilities* (pp 345-363). New York: Guilford.
- Berninger, V.W., Nielsen, K. H., Abbott, R. D., Wijsman, E., & Raskind, W. (2008). Writing problems in developmental dyslexia: under-recognized and under-treated. *Journal of School Psychology*, 46(1), 1-21.
- Berninger, V. W., & Winn, W. (2006). Implications of advancements in brain research and technology for writing development, writing instruction, and educational evolution. In: C. MacArthur, S. Graham, and J. Fitzgerald, (Eds). *Handbook of writing research* (pp 96-114). New York: Guilford
- Blachman, B. A., Schatschneider, C., Fletcher, J., M., Francis, D. J., Clonan, S. M., Shaywitz, B. A., & Shaywitz, S. E. (2004). Effects of intensive reading remediation for second and third graders and a 1-year follow-up. *Journal of Educational Psychology*, 93(3), 444-461.
- Bodrova, E, and Leong, D.J. (1998). Scaffolding Emergent Writing in the Zone of Proximal Development. *Literacy Teaching and Learning* 3(2), 1-17.
- Bodrova, E, and Leong, D.J. (2001). *Tools of the Mind: A case study of implementing the Vygotskian approach in American early childhood and primary classrooms*. Innodata monographs-7, Unesco, International bureau of education.
- Bodrova, E. and Leong, D.J. (2007a). Play and Early Literacy: A Vygotskian Approach. In: K.A. Roskos & J.F. Christie (eds): *Play and*

- Literacy in Early Childhood* (pp 185-200). New York London: Lawrence Erlbaum Associates
- Bodrova, E. and Leong, D.J. (2007b). *Tools of the Mind. The Vygotskian Approach to Early Childhood Education*. Columbus Ohio: Merrill Prentice Hall.
- Boscolo, P. (2009). Engaging and motivating children to write. In: R. Beard, D. Myhill, J. Riley, & M. Nystrand (Eds.), *The Sage Handbook of Writing Development* (pp 300-312). London: Sage.
- Bruner, J.S. (1962). Introduction. In: Vygotsky, L.S. *Thought and Language*. Cambridge, Massachusetts: The M.I.T. Press.
- Bruner, J.S. (1975). From Communication to Language: A Psychological Perspective. *Cognition*, 3, 255-287
- Bruner, J.S. (1983). *Child's Talk. Learning to Use Language*. New York, London: W.W. Norton & Company Inc.,
- Bruner, J.S. (1986). *Actual Minds, Possible Worlds*. Cambridge, Massachusetts, London, England: Harvard University Press.
- Bruner, J.S. (1990). *Acts of Meanings*. Cambridge, Massachusetts, London, England: Harvard University Press,
- Bruning, R. H. & Kauffman, D. F. (2016). Self-efficacy beliefs and motivation in writing development. In C.A. MacArthur, S. Graham, & J. Fitzgerald (Eds), *Handbook of writing research*, (pp 160-173). New York: The Guilford Press.
- Cain, K., Compton, D.L., & Parrila, R.K., (2017). Introduction. In: K. Cain, D. L. Compton, & R.K. Parrila (Eds.), *Theories of readingdevelopment*. Amsterdam/Philadelphia: John Benjamins Publishing Company.
- Cazden, C.B. 1979). Peekaboo as an instructional model: Discourse development at home and at school, pp 1-29. In: *Papers and reports on child language development, volume 17*, Department of linguistics, Stanford University.
- Clark, E.V. (2016). *First Language Acquisition*. Cambridge University Press.
- Cohen, L. & Manion, L. (1994). *Research methods in education*. London, New York: Routledge.
- Cole, A.D. (2006). Scaffolding beginning readers: Micro and macro cues teachers use during student oral reading. *The Reading Teacher*, 59(5), A Journal of the International Reading Association.
- Creswell, J.W. (2013). *Qualitative inquiry and research design*. LA: Sage
- Cullen, J., Richards, S.B. & Frank, C.L. (2008). Using software to enhance the writing skills of students with special needs. *Journal of Special Education Technology* 23(2), 33-44.
- D'Agostino, J.V., Rodgers, E., Harmey, S., and Brownfield, K. (2016). Introducing an iPad app into literacy instruction for struggling readers. *Journal of Early childhood Literacy* 16(4), 522-548.
- Dalby, M. A. (1991). *Bogen om lesing*. Kobenhavn: Danmarks paedagogiske institut.
- van Daal, & Reitsma, P. (2000). Computer-assisted learning to read and spell: result from two pilot studies. *Journal of Research in Reading*, 23, 181-193.
- Dahl, I. (1997). *Orator Verbis Elektris. Taldatorn en pedagogisk länk till läs- och skrivfärdighet*. Akademiska avhandlingar vid Pedagogiska institutionen, Umeå universitet, nr 44.

- Dahl, I. & Galyas, K. (1987). Experiences with the use of computer programs with speech output in teaching reading and writing. In J. Laver & M.A. Jack (Eds.). *European Conference on Speech Technology*, Edinburgh, September 1987, Vol. 11, Edinburgh: CEP Consultants, 422-425.
- DeMott Painter, D. (2002). *What Happens When Students Use Text-to-Speech and Word Predict Program to Compose Text?* LD online, the educational guide to learning disabilities and ADHD. Retrieved from Internet on 28.1 2015 at <http://www.ldonline.org/article/5762>
- Druid Glentow, B. (2006). *Förebygga och åtgärda läs- och skrivsvårigheter. Metodisk handbok*. Stockholm: Natur och kultur.
- Ehri, L.C. (2000). Learning to read and learning to spell are one and the same, almost. In: C. Perfetti, L. Rieben & M. Fayol (Eds.), *Learning to spell: research, theory and practice across language*, (pp 237 – 269). Mahwah, NJ Erlbaum.
- Ehri, L.C. (2000). Learning to read and learning to spell: Two sides of a coin. *Topics in Language Disorders* 20, 19 - 36.
- Elbro, C. (2004). *Läsning och läsundervisning*. Stockholm: Liber.
- Elbro, C., Rasmussen, J., & Spelling, B. (1996). Teaching reading to disabled readers with language disorders. A controlled evaluation of synthetic speech feed-back. *Scandinavian Journal of Psychology*, 37 (2), 140-155.
- Elliott, J.G., & Grigorenko, E.,L. (2014) *The dyslexia debate*. New York: Cambridge University Press
- Englert, C.S., & Mariage, T. (2013). The sociocultural model as a framework for instructional intervention research. In: H.L. Swanson, K.R. Harris, & S. Graham (Eds.). *Handbook of learning disabilities*, (pp 545-564). New York London: The Guilford Press.
- Englert, C.S., Zhao, Y., Dunsmore, K., Callings, N.Y., & Wollbers, K. (2007). Scaffolding the writing of students with disabilities through procedural facilitation: Using an internet-based technology to improve performance. *Learning Disability Quarterly*, 30 (1), 9-29.
- Englert, C.S., Raphael, T.E., Anderson, L.M., Anthony, H.M., & Stevens, D. (1991) Making strategies and self-talk visible: writing instruction in regular and special education classrooms. *American Educational Research Journal* 28 (2)
- European Agency for Development in Special Needs Education (2013). *Information and Communication Technology for Inclusion – Research Literature Review*. Odense, Denmark: European Agency for Development in Special Needs Education.
- Eysenck, M.W., & Keane, M.T. (2000). *Cognitive Psychology*. Hove and New York: Psychology Press.
- Fant, G. (1985). Speech Technology – Research and Development. In: *Ericsson Review* 62(3), 100-107.
- Fast, C. (2007). Sju barn lär sig läsa och skriva. Familjeliv och populärkultur i möte med förskola och skola. *Acta Universitatis Upsaliensis. Uppsala Studies in Education* 115.
- Fasting, R., B. & Halaas Lyster, S.-A. (2005). The effect of computer technology in assisting the development of literacy in young struggling readers and spellers. *European Journal of Special Needs Education*, 20(1), 21-40.
- Fayol, M. (2016). From language to text. The development and learning of translation. In C.A. MacArthur, S. Graham, J. Fitzgerald,

(Eds). *Handbook of writing research*, (pp 130-143). New York: The Guilford Press.

Finne, T., Roås, S. & Kjolholdt, K. (2014). Den første skrive- og leseleeringen. Bruk av PC med lyd støtte. *Bedre Skole nr. 2*. Utdanningsforbundet, Norge.

Finnish National Board of Education (2014). *National Core Curriculum for Basic Education*. (Grunderna för läroplanen för den grundläggande utbildningen). Retrieved from <https://eperusteet.opintopolku.fi> (in Swedish)

Fitzgerald, G., Koury, K. and Mitchem, K. (2008). Research on computer-mediated instruction for students with high incidence disabilities. *Journal of Educational Computing Research* 38(2), 201-233.

Florit, E. & Cain, K. (2011). The simple view of reading: is it valid for different types of alphabetic orthographies? *Educational Psychological Review*, 23, 553-576.

Foley, A. and Ferri, B.A. (2012). Technology for people, not disabilities: ensuring access and inclusion. *Journal of Research in Special Educational Needs* 12(4), 192-200.

Fälth, L., Gustafson, S., Tjus, T., Heimann, M. & Svensson, I. (2013). Computer-assisted Interventions Targeting Reading Skills of Children with Reading Disabilities - A Longitudinal study. *Dyslexia*, 19(1), 37-53.

Fälth, L. & Svensson, I. (2015). An app as 'Reading Glasses' - a study of the interaction between individual and assistive technology for students with a dyslexic profile. *International Journal of Teaching and Education*, Vol. III (1), 1-12.

Garcia, J. R., & Cain, K. (2014). Decoding and reading comprehension: A meta-analysis to identify which reader and assessment characteristics influence the strength of the

relationship in English. *Review of Educational Research*, 84(1), 74-111.

Georgiou, G.K., Torppa, M., Manolitsis, G., Lyytinen, H., & Parrila, R. (2012). Longitudinal predictors of reading and spelling across languages varying in orthographic consistency. *Reading and Writing* 25, 321-346.

Gough, P.B., & Tunmer W.E. (1986). Decoding, reading and reading disability. *Remedial and Special Education* 7(1), 6-10.

Graham, S. (2006). Strategy instruction and the teaching of writing. In: C.A. MacArthur, S. Graham, J. Fitzgerald (Eds.). *Handbook of writing research* (pp 187-207). New York: The Guilford Press.

Graham, S., Harris K.R., & McKeown, D. (2013). The writing of students with learning disabilities, meta-analyses of self-regulated strategy development writing intervention studies, and future directions: redux. In: H.L. Swanson, K.R. Harris, & S. Graham (Eds.), *Handbook of learning disabilities* (pp 405-438). New York London: The Guilford Press.

Granström, B. (1987). *Speech technology for the visually impaired - the Swedish perspective*. *STL-QPSR* 1, 29-38.

Grenfell, M. (2009). Bourdieu, language and literacy. *Reading Research Quarterly*, 44(4), 438-448.

Grunér, S., Östberg, P. & Hedenius, M. (2018). The compensatory effect of text-to-speech technology on reading comprehension and reading rate in Swedish school-children with reading disability: the moderating effect of inattention and hyperactivity symptoms differs by grade group. *Journal of Special Education Technology* 33(2), 98-110.

- Hagtvét, B.E. (2009). När riskbarn möter klassrumspraxis. In: L. Bjar & A. Frylmark (Eds.), *Barn läser och skriver* (pp 169-192). Lund: Studentlitteratur..
- Hall, N. (2009). Developing an understanding of punctuation. In: R. Beard, D. Myhill, J. Riley, & M. Nystrand (Eds.), *The Sage Handbook of Writing Development* (pp 271-283). London: Sage.
- Hammil, D. (2005). What we know about correlates of reading. *Exceptional Children* 70. (4), 453-468
- Hannus-Gullmets, B. (1999). *Syntetiskt tal på dator som hjälpmedel vid läs- och skrivträning med finlandssvenska elever*. Rapporter från Pedagogiska fakulteten vid Åbo Akademi, Nr 18.
- Hayes, J.R. (2006). New directions in writing theory. In: C.A. MacArthur, S. Graham, & J. Fitzgerald (Eds.). *Handbook of writing research* (pp 96-114). New York: The Guilford Press.
- Hayes, J. R. (1996). A new framework for understanding cognition and affect in writing. In C. M. Levy & S. Ransdell (Eds.), *The science of writing. Theories, methods, individual differences, and applications* (pp. 1-27). Hillsdale, NJ: Erlbaum.
- Hayes, J.R., & Flower, L. (1980). Identifying the organization of writing processes. In: L.W. Gregg, E.R. Steinberg (Eds.), *Cognitive processes in writing: An interdisciplinary approach* (pp 3-30). Hillsdale, NJ: Erlbaum.
- Heimann, M., & Gustafson, S. (2009) Lärande, läsning och multimodalitet. In: L. Bjar & A. Frylmark (Eds.), *Barn läser och skriver* (pp 193-212). Lund: Studentlitteratur
- Hidi, S., & Boscolo, P. (2006). Motivation and writing In: C.A. MacArthur, S. Graham, & J. Fitzgerald (Eds.). *Handbook of writing research* (pp 144-157). New York: The Guilford Press.
- Higgins, E. L. & Raskind, M. H. (2005). The compensatory effectiveness of the quicktionary reading pen II on the reading comprehension of students with learning disabilities. *Journal of Special Education Technology*, 20 (1), 31-40.
- Hobsbaum, A. Peters, S., and Sylva, K. (1996). Scaffolding in Reading Recovery. *Oxford Review of Education*, 22 (1), 17-34
- Hoen, T. & Lundberg, I. (1999). *Dyslexi. Från teori till praktik*. Stockholm: Natur och kultur.
- Hoen, T. & Lundberg, I. (2000). *Dyslexia: From Theory to Intervention*. Dordrecht: Springer.
- Hoover, W.A. & Gough, P.B. (1990). The simple view of reading. *Reading and Writing*, 2 (2) 127-160.
- Hultin, E., & Westman, M. (2013). Early Literacy Practices Go Digital. *Literacy Information and Computer Education Journal*, 4 (4), 1005-1013.
- Hultin, E., & Westman, M. (2014). Digitalisering av den tidiga läs- och skrivundervisningen. In: E. Hultin & M. Westman, (Eds.), *Att skriva sig till läsning* (pp 113-142). Malmö: Gleerups.
- Hyltefors Nyström, M. (2011). Kan tangentbordsträning tillsammans med talsyntes stärka bokstavskännet och ordavkodningsförmåga hos elever med språkstörning? In: Y. Segnestam & U. Föhrer, (Eds.), *Från bokstäver till förståelse - rapportsamling om läs- och skrivprocessen, normal och avvikande utveckling*. Specialpedagogiska skolmyndigheten, Sverige.

- Inns, A., Lake, C., Pellegrini, M., & Slavin, R. (2018). *Effective programs for struggling readers: A best-evidence synthesis*. Paper presented at the annual meeting of the Society for Research on Educational Effectiveness, Washington, DC.
- Johansson, M-G (2010). *Datorträning I läsflyt och stavning: Analys och utvärdering av fixerad och resultatstyrd flash-card exponering*. Doktorsavhandling vid Umeå universitet, samhällsvetenskapliga fakulteten, psykologi.
- Johnson, R. B. & Onwuegbuzie, A. J. (2004) Mixed methods research: A research paradigm whose time has come. *Educational Researcher*, 33(7) 14 -26.
- Juel, C., Griffith, P.L., & Gough, P.B. (1986). Acquisition of Literacy. A longitudinal Study of Children in First and Second Grade. *Journal of Educational Psychology* 78(4) 243-256.
- Kemp, S.L. & Korkman, M. (2010). *Essentials of NEPSY-II assessment*. New Jersey: Wiley & Sons.
- Korkman, M. (1990). NEPSY *Neuropsykologisk undersökning 4-7 år*. Svensk version. Stockholm: Psykologiförlaget.
- Kress, G. (2003) *Literacy in the new media age*. New York: Routledge
- Leith, G., Yull, N., & Pike, A. (2018). Self-regulation and other-regulation perspectives to a scaffolded task. *British journal of Educational Psychology* 88(2) 174-191.
- Liberg, C. (1990). Learning to read and write. *Reports from Uppsala University Department of Linguistics (RUUL) 20*. Uppsala university: Department of Linguistics
- Liberg, C. (2007). Läsande, skrivande och samtalande. In: *Att läsa och skriva – forskning och beprövad erfarenhet*. Myndigheten för skolutveckling, 4, (pp 25-44). Stockholm: Liber.
- Liberg, C. (2014). *Att använda dator i tidig läs- och skrivundervisning 2011-2014, Uppsala kommun. Slutrapport för ASL-projektet*. Institutionen för pedagogik, didaktik och utbildningsstudier, Uppsala universitet.
- Liljencrants, J. (1967). The Ove III speech synthesizer. *STL-QPSR*, 8, (2-3), 76-81.
- Lindell, E. (2006). *Om rättskrivning, fakta och kuriosa*. Uppsala: Årsböcker i svensk undervisningshistoria.
- Lundberg, I. (2008). *God skrivutveckling. Kartläggning och utveckling*. Stockholm: Natur Kultur Läromedel.
- Lyytinen, H., Erskine, J., Kujala, J., Ojanen, E., & Richardson, U. (2009). In search of a science-based application: A learning tool for reading acquisition. *Scandinavian Journal of Psychology*. 50(6), 668-675.
- MacArthur, C. A. (1998). From Illegible to Understandable: How Word Prediction and Speech Synthesis Can Help. *Teaching Exceptional Children*, 6, 66-71
- MacArthur, C.A. (2009). Reflections on Research on Writing and Technology for Struggling Writers. *Learning Disabilities Research & Practice*, 24(2), 93-103.
- MacArthur, C.A. (2013). Technology applications for improving literacy. A review of research. In H.L. Swanson, K.R. Harris, & S. Graham, (Eds.), *Handbook of learning disabilities* (pp 565-590). New York London: The Guilford Press.

- Magnusson, L., Blomberg, M., Carlson, R., Elenius, K. & Granström, B. (1984). Swedish speech researchers team up with electronic venture capitalists. *Speech Technology* jan/febr, 15-24.
- Maor, D., Currie, J. & Drewry, R. (2011). The effectiveness of assistive technologies for children with special needs: a review of research-based studies. *European Journal of Special Needs Education*, 26(3), 283-298.
- Martin, C., 2004. From *other* to *self*. Learning as Interactional Change. Uppsala Studies in Education No 107.
- Martin, C. (2009). Relevance of Situational Context in Studying Learning as Changing Participation. *Scandinavian Journal of Educational Research*, 53(2), 133-149.
- Masters, J.E. and Yelland, N. (2002). Teacher Scaffolding: An Exploration of Exemplary Practice. *Education and Information Technologies*, 7(4), 313-321
- McLaughlin, T.F., Weber, K. P., & Derby, K. M., (2013). Classroom spelling interventions for students with learning disabilities. In: H.L. Swanson, K.R. Harris, & S. Graham, (Eds.), *Handbook of learning disabilities* (pp 439-447). New York London: The Guilford Press.
- Melby-Lervåg, M., Lyster, S.-A. H., & Hulme, C. (2012). Phonological skills and their role in learning to read: A meta-analytic review. *Psychological Bulletin*, 138(2), 322-352.
- Merriam, S. B. (1988). *Case study research in education*. San Francisco, CA: Jossey-Bass.
- Merriam, S. B. (2009). *Qualitative research*. San Francisco, CA: Jossey-Bass.
- Myhill, D. & Jones, S. (2018). Lost for words: Instructional approaches to support older struggling writers. In: B. Miller, P. McCardie, & V. Connelly (Eds.), *Writing development in struggling learners* (pp 141-158). Leiden, Boston: Brill.
- Myrberg, M. (2009). Pedagogiska kontroverser kring dyslexi/läs- och skrivsvårigheter. In S. Samuelsson, Arnqvist, A., Björn, M., Dahlin, K., & Elwér, Å. *Dyslexi och andra svårigheter med skriftspråket* (pp 322-349). Stockholm: Natur och Kultur.
- Mäki, H., Vauras, M.M.S., & Vainio, S. (2002). Reflective spelling strategies for elementary school students with severe writing difficulties: a case study. *Learning Disability Quarterly*, 25, 189-207.
- National Advisory Board on Research Ethics. (2009). *Ethical principles of research in the humanities and social and behavioural sciences and proposals for ethical review*. Helsinki.
- National Early Literacy Panel. (2008). *Developing early literacy: Report of the National Early Literacy Panel*. Washington, DC: National Institute for Literacy.
- National Reading Panel. (2000). *Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instructions*. Bethesda, MD: National Institute of Child Health and Human Development (NICHD).
- Naucmér, K. (1989). Hur utvecklas stavningsförmågan under skoltiden? In C. Sandqvist & U. Telemann (Eds.), *Språkutveckling under skoltiden* (pp 197-216). Lund: Studentlitteratur
- Naucmér, K. & Magnusson, E. (1985). *Språket i skrift: om normal och försenad utveckling av tal och skrift*. Praktisk lingvistik nr 10. Institutionen för lingvistik, Lunds universitet.

- Ninio, A., & Bruner, J. (1978). The Achievement and Antecedents of Labelling. *Journal of Child Language* 5, 1-15
- Ochs, E. (1979) Transcription as Theory. In E. Ochs & B. B. Schieffelin (Eds.), *Developmental Pragmatics* (pp 43-72). New York: Academic Press
- Ochs, E., Schegloff, E.A. & Thompson, S.A. (1996). Transcription conventions. Appendix. In: E. Ochs, E.A. Schegloff & S.A. Thompson (Eds). *Interaction and grammar* (pp 461-465). Cambridge: Cambridge University Press.
- Olofsson, Å. (1992). Synthetic speech and computer aided reading for reading disabled children. *Reading and Writing: An Interdisciplinary Journal*, 4(2), 165-178.
- Olson, R.K. and Wise, B.W. (1992). Reading on the computer with orthographic and speech feed-back. *Reading and Writing: An Interdisciplinary Journal*, 4(2), 107-144.
- Olson, R.K. and Wise, B.W. (2006). Computer-based remediation for reading and related phonological disabilities. In M. C. McKenna, L.D. Labbo, R. D. Kieffer, & D. Reinking (Eds.), *International handbook of literacy and technology*, 2, 57-73. Mahwah, NJ: Erlbaum.
- Parrila, R., & Protopapas, A. (2017). Dyslexia and word reading problems. In K. Cain, D. L. Compton, & Parrila, R. K. (Eds.), *Theories of reading development* (pp 330-358). Amsterdam Philadelphia: John Benjamins.
- Piasta, S.B., & Wagner, R.K. (2011). Developing early literacy skills: A meta-analysis of alphabet learning and instruction. *Reading Research Quarterly*, 45 (1), 8-38.
- Postholm, M.B. (2015). Methodologies in cultural history activity theory: The example of school-based development. *Educational Research*, 57(1) 43-58.
- Raven, J. (1981). *Manual for Raven's progressive matrices and vocabulary scales*. San Antonio, Texas: Harcourt Assessment.
- Read, C. (2009). Learning to use alphabetic writing. In: R. Beard, D. Myhill, J. Riley, & M. Nystrand (Eds.). *The Sage Handbook of Writing Development* (pp 260-270). London: Sage
- Reid, G., Strnadová, I. & Cumming, T. (2013). Expanding horizons for students with dyslexia in the 21st century: universal design and mobile technology. *Journal of Research in Special Educational Needs*, 13, 175-181.
- Riley, J., & Reedy, D. (2000). *Developing writing for different purposes. Teaching about genre in the early years*. London: Paul Chapman Publishing Ltd.
- Ripoll Salceda, J.C., Aguado Alonso, G., & Castilla-Earls, A. P. (2013). The simple view of reading in elementary school: A systematic review. *Revista de Logopedia, Foniatria y Audiologia*.
- Rodgers, E. M. (2004). Interactions that scaffold reading performance. *Journal of Literacy Research*, 36 (4), 501-532.
- Rodgers, E., D'Agostino, J.V., Harmey, S.J., Kelly, R.H., & Brownfield, K. (2016). Examining the nature of scaffolding in an early literacy intervention. *Reading Research Quarterly*, 51(3), 345-360.
- Roskos, K.A., & Christie, J.F. (2007). Preface. In: K.A. Roskos, & J.F. Christie (Eds.): *Play and Literacy in Early Childhood*. New York London: Lawrence Erlbaum Associates,
- Rogoff, B. (2003). *The cultural nature of human development*. Oxford University Press.

- Russell, D.R. & Yanes, A. (2003). "Big picture people rarely become historians": Genre systems and the contradictions of general education. In C. Bazerman & D. R. Russell (Eds), *Writing selves/writing societies: Research from activity perspectives* (pp 331-362). Retrieved February 15, 2018 from wac.colostate.edu/books/selves_societies/russell/
- Saine, N. L., Lerkkanen, M.-K., Ahonen, T., Tolvanen, A., & Lyytinen, H. (2011). Computer-assisted remedial reading intervention for school beginners at risk for reading disability. *Child Development, 82, 3, 1013-1028.*
- Sawyer, R. K. (2008). Optimising learning: implications of learning sciences research. OECD/CERI International conference "Learning in the 21th century: research, intervention and policy"
- Scarborough, H. (1998) Early identification of children at risk for reading disabilities. Phonological awareness and some other promising predictions. In B.K. Shapiro, P.J. Accardo & A.J. Capute (Eds). *Specific Reading Disability. A View of the Spectrum.* Maryland: York press.
- Schegloff, E. A., Jefferson, G., & Sacks, H. (1977). The preference for self-correction in the organization of repair in conversation. *Language, 53(2), 361-382.*
- Schegloff, E. A. (1992). Repair after next turn: The last structurally provided defense of intersubjectivity in conversation. *American Journal of Sociology, 97(5), 1295-1345.*
- Seymour, P.H.K., Aro, M., & Erskine, J.M. (2003). Foundation literacy acquisition in European orthographies. *British Journal of Psychology, 94, 143-174.*
- Skoog, M. (2012). *Skriftspråkande 1 förskoleklass och årskurs 1.* Örebro Studies in Education, 33.
- Snow, C.E., & Ninio, A. (1986). The Contracts of Literacy: What Children Learn from Learning to Read Books., In: W.H. Teale, E. Sulzby (Eds.), *Emergent Literacy: Writing and Reading* (pp 116-138). Norwood New Jersey: Ablex Publishing Corporation.
- Spec-Nytt (2009). *Spel-Ett och LukiMat-webbtjänsten på svenska! (1), p 10.* Svenskfinslands specialpedagogiska förening r.f.
- Stanovich, K. (2000). *Progress in understanding reading.* New York London: The Guilford Press.
- Stanovich, K.E., Cunningham, A., & Cramer, B. (1984). Assessing phonological awareness in kindergarten children. *Journal of Experimental Child Psychology, 38, 175-190.*
- Stake, R.E. (1995). *The art of case study research.* Thousand Oaks, CA: Sage Publications.
- Stone, C.A. (1998). The metaphor of scaffolding: Its utility for the field of learning disabilities. *Journal of Learning Disabilities, 31(4), 344-364*
- Svensson, I. (2015). Alternativa verktyg, vad har vi lärt oss hittills. *Dyslexi, aktuellt om läs- och skrivsvårigheter, 3, 4-8.*
- Svensson, I., Nordström, T., Lindeblad, E., Gustafson, S., Björn, M., Sand, C., Almgren/Bäck, G., & Nilsson, S. (2019). Effects of assistive technology for students with reading and writing disabilities. *Disability and Rehabilitation: Assistive Technology, DOI: 10.1080/17483107.2019.1646821.*

- Taube, K. (2011). *Barns tidiga skrivande*. Stockholm: Norstedts Akademiska Förlag.
- Taube, K. (2007). *Barns tidiga läsning*. Stockholm: Norstedts Akademiska Förlag.
- Taube, K., Fredriksson, U., & Olofsson, Å. (2015). *Kunskapsöversikt om läs- och skrivundervisning för yngre elever*. Delrapport från SKOLFORSK-projektet. Vetenskapsrådet. Stockholm.
- Taube, K., Tornéus, M. & Lundberg, I. (1984). *UMESOL – Umeå läs- och skrivmaterial för lågstadiet*. Hägersten: Psykologiförlaget.
- Tharp, R.G., & Gallimore, R. (1988). *Rousing minds to life: teaching, learning and schooling in social context*. Cambridge: Cambridge University Press.
- Tolchinsky, L. (2016). From text to language and back. The emergence of written language. In C.A. MacArthur, S. Graham, & J. Fitzgerald (Eds.), *Handbook of writing research* (pp 144-159). New York: The Guilford Press.
- Tolchinsky, L. (2006). The Emergence of Writing. In C.A. MacArthur, S. Graham, & J. Fitzgerald (Eds.), *Handbook of writing research* (pp 83-95). New York: The Guilford Press.
- Torppa, M., Georgiou, G.K., Lerkkanen, M-L, Niemi, P., Poikkeus, A-M, & Nurmi, J-E. (2016). Examining the simple way of reading in a transparent orthography: A longitudinal study from kindergarten to grade 3. *Merrill-Palmer Quarterly*, 62(2), 179-206.
- Trageton, A. (2005). Creative Writing on Computers: 6- to 10-Year-Olds Writing to Read. In: M. Pandis, A. Ward & S.R. Mathews, Eds, *Reading, Writing, Thinking: Proceedings of the 13th European Conference on Reading*.
- UNESCO (2018). <https://en.unesco.org/themes/literacy>. Retrieved 2018-02-27.
- UNRIC (2017). <https://www.unric.org/en/literacy/27791-the-evolving-definition-of-literacy>. Retrieved 2018-02-27.
- Vahtivuori-Hänninen, S., Halinen, I., Niemi, H., Lavonen, J., & Lipponen, M. (2014). A new Finnish national core curriculum for basic education (2014) and technology as an integrated tool for learning. In: H Niemi, J. Multisilta, L. Lipponen & M. Vivitsou (Eds.) *Finnish Innovations & Technologies in Schools, 21-32*.
- Van de Pol, J., Volman, M., & Beishuizen, J. (2010). Scaffolding in Teacher-Student Interaction: A Decade of Research. *Educational Psychology Review* 22 271-296
- Van Waes, L., Leiten, M., Wengelin, Å, & Lindgren, E. (2012). Logging tools to study digital writing processes. In V.W. Berninger, (Ed.), *Past, present and future contributions of cognitive writing research to cognitive psychology* (pp 507-533). New York/Sussex: Taylor & Francis.
- Wasik, B. & Slavin, R. E. (1993). Preventing early reading failure with one-to-one tutoring: A review of five programs. *Reading Research Quarterly* 28(2), 178-200.
- Vellutino, F. (2014). Foreword. In: J. G. Elliott & E.J. Grigorenko (Eds.), *The dyslexia debate*. New York: Cambridge University Press.
- Vellutino, F.R., Scanlon D.M. & Tanzman, M.S. (1998). The case for early intervention in diagnosing specific reading disability. *Journal of School Psychology* 36(4), 367-97.
- Vellutino, F.R., Fletcher, J.M., Snowling, M.J. & Scanlon, D.M. (2004). Specific reading disability (dyslexia): what have we learned

in the past four decades? *Journal of Child Psychology and Psychiatry*, 45(1), 2-40.

Wengelin, Å. (2009). Språket i tal och skrift. In L. Bjar & A. Frylmark (Eds.). *Barn läser och skriver* (pp 127-148). Lund: Studentlitteratur.

Wengelin, Å. (2013a). Att tillägna sig skriftspråket. In Å. Wengelin. & C. Nilholm (Eds.), *Att ha eller sakna verktyg* (pp 63-86). Lund: Studentlitteratur.

Wengelin, Å. (2013b). Tal och skrift. In Å. Wengelin & C. Nilholm (Eds.), *Att ha eller sakna verktyg* (pp 13-34). Lund: Studentlitteratur.

Wengelin, Å. & Arfé, B. (2018). The complementary relationships between reading and writing to children with and without writing difficulties. In: B. Miller, P. McCardie, & V. Connelly (Eds.). *Writing development in struggling learners* (pp 29-50). Leiden, Boston: Brill.

White, D. H. & Robertson, L. (2015). Implementing assistive technologies: A study of co-learning in the Canadian elementary school context. *Computers in Human Behavior*, 51, 1268-1275.

Wise, B. W., & Olson, R. K. (1992). How poor readers and spellers use interactive speech in a computerized spelling program. *Reading and Writing: An Interdisciplinary Journal* 4, 145-164.

Wise, B. W., Ring, J., & Olson, R. K. (1996). Individual differences in gains from computer-assisted remedial reading. *Journal of Experimental Child Psychology*, 77, 197-238.

Wood, D., Bruner, J.S., & Ross, G. (1976). The role of tutoring in problem solving. *Journal*

of Child Psychology and Psychiatry, 17, 89-100.

Wolff, U. (2011). Effects of a Randomised Reading Intervention Study: An Application of Structural Equation Modelling. *Dyslexia*, 17(4), 295-311.

Wolff, U. (2012). Dyslexi – en pedagogisk utmaning. In L. Pohler (Ed.), *Dyslexi – en fælles nordisk udfordring* (pp 73-84). Copenhagen: Landsforeningen af læsepedagoger.

Vygotsky, L.S. (1962) *Thought and Language*. Cambridge, Massachusetts: The M.I.T. Press,

Vygotsky, L. S. (1978). *Mind in society. The development of Higher Psychological Processes*. Harvard University Press, Cambridge, Massachusetts, London, England.

Yelland, N. & Masters, J. (2007). Rethinking scaffolding in the information age. *Computers and Education* 48, 362-382

Yull, N. & Carr, A. (2018). Scaffolding: integrating social and cognitive perspectives on children's learning at home. *British journal of Educational Psychology* 88(2)

Yin, R. K. (1994). *Case study research. Design and Methods*. Second Edition. Thousand Oaks, CA: Sage.

Yin, R. K. (2009). *Case Study Research. Design and Methods*. Fourth Edition. Thousand Oaks, CA: Sage.

Yin, R. K. (2014). *Case Study Research. Design and Methods*. Fifth Edition. Thousand Oaks, CA: Sage.

Appendices

Appendix 1. Transcription conventions

Adapted from Ochs, Schegloff & Thompson, (1996, pp 461-465) and Martin, (2004, pp 199-201).

[Separate left brackets, one above the other on two successive lines with [utterances by different speakers, indicates a point of overlap outset

() Parentheses indicates a pause.

: Colons are used to indicate the prolongation or stretching of sound just proceeding them.

Word Bold-faced letters or words are used to indicate some form of stress or emphasis.

((laugh)) Double parentheses are used to mark the transcriber's description of events rather than representations of them.

Appendix 2. Assessment Report, Case 1, Michael. Translation

Testing 1.

Date: 1.12, 15.12, 17.12 1993

Assessment methods used: Parts of Umesol, parts of NEPSY, Raven

Assessor: psychologist Carina Hagkvist

General: Michael is at preschool, in an age-integrated group with children from preschool and from grade one and two at primary school. According to information from the teachers, more Finnish than Swedish is spoken in his home. Both Michael's comprehension and use of spoken language are slightly below average. Compared to his age group, his reading skills are weak. He has reached a level of pseudo-reading where he associates pictures with certain words. His writing skills are on an average level compared to his age group. The stage of Michael's writing development is currently logographic spelling. He writes single words, but he perceives the words as pictures, and he has not understood the principle of writing. His interest in and his motivation for reading and writing are satisfactory. Michael works well emotionally and motorically. In terms of learning style, Michael has difficulties in getting started with tasks that require attention.

Phonological Awareness

Michael's phonological awareness is still weak. He segments incompletely into syllables, e.g. *di-i-ket* (*diket* (*the ditch*) = *di-ket*), and inserts new sounds, such e.g. *fara* (*danger*) becomes *fanra*. Sound synthesis does not work at all, e.g. *låna* (*borrow*) becomes *känna* (*feel*). In contrast, according to the result in NEPSY, the auditory phonemic perception is adequate for his age. Michael does not find it difficult to discern what word is meant by saying e.g. *bal-long* (*bal-loon*) or to perceive what sound or syllable a word begins with. What is still difficult to discern are the individual sounds in words.

Language Functions

According to NEPSY, Michael's language comprehension, when measured in terms of acting upon request, is slightly below average. The understanding of conceptual relationships of the type *nederst* (*at the bottom*) or *kortare* (*shorter*), however, is adequate for his age. In a listening comprehension task in UMESOL, Michael recounts few things spontaneously, but when the tester makes questions, it appears that he perceived has the most important features of the story.

Reading and Writing Skills

Letters are still very uncertain for Michael. We look at the capital letters, of which he recognizes A, S and M. He does not recognize the other letters, or he gives an incorrect answer to them. Writing dictated letters is a little easier. O, A, K, I, M, B and *i, m, s* went off splendidly. When copying text, Max looks at the text for each letter, and he has some difficulties in keeping track of where in the word he is working. His motor skills seem somewhat insecure and he copies the text slowly, which probably is adequate for his age. His handwriting is normal. Number skills, which also fall within this area, are adequate for his age, while reading and writing skills are below average.

General Cognitive Capacity and Memory Functions

His results in Raven show a nonverbal capacity on an average level, possibly slightly above. Memory capacity is largely adequate for his age. However, the ability to repeat words is slightly below average. The inhibitory effect is also about average, i.e. previously learned material is not disturbed to an exceptional degree by newer material.

Summary

The general cognitive capacity and memory capacity are largely about average. In language there appear to be some deficiencies, which may be related to the influence of several languages. The phonological awareness is also weak which indicates that Michael would benefit from linguistic stimulation, e.g. in the shape of nursery rhymes and language games of various kinds.

Testing 2.

Re-testing with Michael

Dates: 27.5, 31.5 1994

Assessment methods used: Parts of Umesol, parts of NEPSY

Assessor: psychologist Carina Hagkvist

About the behaviour during the testing can generally be said that Michael's motivation is not perfect, but he seems to work more confidently, especially with spelling and writing.

Phonological Awareness

The segmentation of sounds is still difficult for Michael. He segments incompletely into syllables, e.g. *vi-l-ar* (*vi-lar = rest*), and he also adds occasional extra sounds e.g. *du-n-ga* (*du-ga =do*). Thus, measured with Umesol, Michael's segmentation skills have not developed significantly since the last test (still

zero correct answers). However, Michael has progressed in sound synthesis data, which is interesting because sound synthesis is considered more difficult than sound segmentation. He can handle phonologically simple words like *mâne* (*moon*), if not always quite correctly, and also a phonologically moderately difficult word, *gapet* (*the mouth*), while the phonologically complex words are still too difficult. As expected, it is easier for Michael to find the vowels by listening, e.g. *duka* (*lay the table*) becomes *kula* (*bullet*), while especially the stop consonants (d, k, b etc.) cause problems. (Compared to previous testing, zero correct responses, Michael now has four correct responses).

Reading and Writing Skills

When copying text, Michael still mostly looks at every single letter, sometimes he takes two letters at a time. Copying may be slightly faster this time, but he still needs twice as long time as the time limit for the task. The letter *n* is reversed as in previous testing. The direction of *a* is also somewhat uncertain.

Letter dictation shows that Michael has learned some new ones since the previous test. He writes *e*, *o*, *m* and *s* of the lower-case letters and of the upper-case letters *O*, *L*, *A*, *R*, *B*, *I*, *M*, *S* (compare with testing 1). *K* and *i* have fallen into oblivion since last time. Michael obviously ventures to try more this time, although he still links the wrong grapheme to many of the phonemes.

Michael has adopted an adequate strategy for writing dictated words. He starts by sounding out the letters for example in *m-i-l*. Michael seems to be rather sure of which sounds are included in phonologically simple words such as *måla*, the difficulty for him consists in finding the right letter for the sounds. It can be said that Michael already writes alphabetically, but since he has not yet learned the letters, it is natural that he does not always write phonetically, e.g. *når* (*when*) becomes *mor* (*mother*).

In letter reading, Michael has taken major steps forward. Of the capital letters he reads 18 out of 24 (compared to 3 in testing 1) and of the lower-case letters 8 out of 24 (compared to 0 in testing 1). Unclear letters among the capital letters are still *E*, *V*, *Ö*, *U*, *Y* and *Å*, thus the more unusual (except *E*). Reading the words written in lower-case will, of course, be difficult as the letters are still unclear to Michael. His reading is still logographic.

Measured with NEPSY, Michael's reading and writing skills are still a standard deviation below the mean level as well as in language comprehension measured by the Token subtest, even though he performs better now in both tests than in testing 1.

In summary, it can be said that Michael approaches reading through writing where he has already reached an alphabetical level. Interestingly, he has not

progressed in sound segmenting (but in contrast in sound synthesis), although sound segmenting is considered more connected to writing.

Letter check, Word Reading Check with Michael at First Grade in School

Date: 1.9 1994

Tester: The special education teacher in Michael's school

Letter knowledge

Upper-case letters 26 of 29

Lower-case letters 25 of 29

Word reading

Phonetic one-syllable words with no consonant combinations with upper-case letters and lower-case

Appendix 3. Written Texts, Overview of the work during the Lessons, Case 1.

Lessons 1 – 4

Michael writes names

MICHAEL, ANNA, ARTUR, NAPPE, VINNI, KLAS, TANJA (lesson 1)

MICHAEL, ANNA, ARTUR, NAPPE, VINNI, KLAS, TANJA, JORA, OLLI (L2)

MICHAEL, ANNA, ARTUR, NAPPE, VINNI, KLAS, TANJA (lesson 3)

DUMMER-JÖNS (lesson 4)

Lessons 5 – 8

Michael writes short sentences

JAG SKA KANSKE KÖPA EN FILM. ROBOCOP (lesson 5)

EMILIA KOMMER TILL MIG IDAG. MAX ANNA ARTUR (lesson 6)

VINNI HAR FÅTT VALPAR. EN HETTE PLUMS. EN HETTE SPLITTE. EN HETTE RAFFEL EN HETTE KIMP. EN HETTE STAPP. (lesson 7)

SKÖLD-PADDAN HETER LASSE. (lesson 8)

Lessons 9 Michael makes a continuation to the sentence in lesson

SKÖLDPADDAN LASSE ÄR PÅ EN PLATS NÄSTAN HELA TIDEN. (lesson 9)

Lessons 10 - 13, 15 - 16 Michael and the teacher play a Hangman-game with letters with speech synthesis, Michael studies out-print of his words

Lesson 14, 17 Michael writes a short sentence, Math Blaster

GLAD PÅSK (lesson 14)

JAG VET INGENTING (lesson 17)

Lesson 18 Michael writes about a puppy called Raffel

RAFFEL VAR DEN FÖRSTA GÅNGEN UTE

Lesson 19 Michael writes numbers 1-9, letters A-G on his own and letters H-Ö with help from the teacher

Lesson 20 Michael writes about a family trip, the lesson is videotaped.

MICHAEL JAG OCH ANNA OCH PAPPAN OCH NAPPE VAR I HELSINGFORS. VI VAR I HELSINGFORS HOS MIN MORMOR.

Appendix 4. Assessment Report, Case 2, Marc. Translation

Testing 1.

Date: 8.11, 15.11 1994

Assessment methods used: Parts of Umesol, parts of NEPSY, Raven

Assessor: psychologist Carina Hagkvist, Britta Hannus-Gullmets (Letter Knowledge, Phonological Awareness)

Marc is in the first grade. According to his teachers, he knows some letter names, but he does not know letter sounds. He cannot read words, not even short words.

Phonological Awareness

According to Umesol, Marc's phonological awareness is still weak. He segments incompletely in syllables, for example *å* – *a* for *måla* (paint) and *f-a-a* for *fara* (danger). However, he finds the vowels. He does not at all succeed in doing sound synthesis. He just mentions the first or last sound in the word. The result in Umesol Phonological Awareness Test was zero, but his result in auditory-phonemic perception according to NEPSY was better.

Language Functions

Language understanding according to NEPSY Token test is – 3 standard points, which is clearly below the average level. The understanding of conceptual relationships is slightly below intermediate level, - 1,5 standard points. The auditory-phonemic perception according to NEPSY, which means perceiving word parts and individual sounds, is at 0 standard points, which means average level.

Reading and Writing skills

Marc could tell 17 names out of 28 uppercase letters and 15 names out of 28 lowercase letters. The skills in reading and writing are slightly below the average level, -1 standard point according to NEPSY.

General Cognitive Capacity and Memory Functions

The general cognitive capacity according to Raven is above the average level, (Level 2). The result for series of numbers according to NEPSY is at an average level. In terms of word series and inhibition effect, i.e. how previously learned material affects new material, the result is slightly below the average, -1 standard score.

Testing 2.

Date: 31.1 1995, 20.2 1995

Phonological Awareness According to Umesol

Now Marc segments the words mainly in a correct way, even if he sometimes leaves out a speech sound. For example, he segments *vilar* (rests) as *v-i-l-a*, and *löpa* (run) as *l-ö-pa*. Sound segmentation has progressed from 0 to 3 correct responses in the second testing.

Marc has also progressed in sound synthesis tasks. He succeeds with two phonologically simple words, *måne* (moon) and *rasa* (crash down), and with one word of phonologically moderate difficulty, *påle* (pole). When he makes mistakes, he does not totally misunderstand the word, he only leaves out or replaces a single letter. Marc also managed to make sound synthesis of a phonologically complex word, *blöta* (wet). Sound synthesis has progressed from 0 to 4 correct responses in the second testing.

Language Functions

Listening comprehension. Marc managed to spontaneously tell 18 details out of 26 possible in the listening comprehension task in Umesol. The result indicates a good language understanding as well as a good ability to remember and retell.

Reading and Writing Skills

Marc knew 19 out of 24 uppercase letters and 15 out of 24 lowercase letters.

Reading and writing skills are now at an average level according to NEPSY. The difference to the previous testing is that Marc now

- 1) Recognises the first letter of the words
- 2) Reads short sentences of the type "point to the door"
- 3) Is on the right path to learning to spell correctly (e.g. he writes *fotbol* for *fotboll* (football) instead of *få* in the first testing)

Reading and Writing Skills According to Umesol

When reading single words without a time limit, the result was 27 correct words of 34. Marc finds the words by sounding out the letters. He manages well to read phonologically simple and moderately difficult words, but phonologically difficult and non-phonetic words are more difficult. His reading

errors consist of confusion of visually similar letters, long and short vowel, reversals and extra letters.

When copying text, Marc looks at the text letter by letter, sometimes at two letters at a time. His decoding is not that automated that he would have read the text.

The writing task consists of phonologically simple words, for example *mil* (six miles), which Marc manages well to write (4 correct out of 6 possible). He confuses *o* and *å* in *måla* (paint) and *månen* (the moon).

Summary

Phonological awareness has developed greatly between the first and the second testing. He segmented incompletely at the first testing and did not handle sound synthesis at all. At the second testing, he mainly managed both segmentation and synthesis, only with minor mistakes.

Marc has also made significant progress in reading and writing compared to the first testing. He has cracked the code and reads using the phonological strategy. He can spell phonetic words of the type *meta* (angle), and he can also partially cope with non-phonetic words like *fotboll* (football) (he wrote *fotbol*). He has problems with *o-å*, *e-ä* and double consonant.

Appendix 5. Written Texts, Overview of the Work during the Lessons. Case 2

Lesson 1-5 Strings of letters, random words, names of family members

w m a z t w v s v

Vnm vi lkmh sa sa sam sab bas bas (lesson 1)

SAB BAS XZO ZO.

WIN ÄÖÄ MÅÅÖ WV.

ANNE OCH HANS OCH MATS OCH ANTONIA (lesson 2)

Mats och Anne och Hasse och Antonia.nnmnmnm m n mnnnnnnnm (lesson 3)

Tct vct vc böoc bok kob ko nos

Mats och Anne och Hasse och Antonia och Jolli. (lesson 4)

ÖTZÖ SÖT MÖSS MÖSSA MIÖ KTMI KITM (lesson 5)

Lessons 6-10 Words in the surroundings or suggested by the teacher

MANDEL. PAPPA OCH MAMMA (lesson 6)

VÄSKA BOK (lesson 7)

LAMPA BOLL BOK SPEL LILLA JUL LIM KUL (lesson 8)

KORG KO KORV DIT DITT PÅRM MAPP TA MAT DATA (lesson 19)

stol golv. god jul! raket taxi. (lesson 10)

Lessons 11 – 14 Short sentences in stories

vi var och skidade till öjbärget.

sen for vi hem. (lesson 11)

först for vi till jacks kalas. och

han är 8 år. (lesson 12)

vi sökte en skatt.

där fanns godis (lesson 13)

Först for vi till Jacks kalas. Och

han är 8 år. Vi sökte en skatt.

Där fanns godis. Och presenten var

en bygg sats. Sen for vi hem. (lesson 14)

Lessons 15-18 A story about a football match

Bkfk City är mitt fotbollslag.

Vi hade match mot smedsby. (lesson 15)

Vi förlorade mot smedsby och jag
jorde ett mål . (lesson 16) Jag jorde ett mål
så att målvakten stod i stolpen
och jag sköt i anra såpen (lesson 17)

Bkifk City är mitt fotbollslag.
Vi hade match mot Smedsby.
Vi förlorade mot Smedsby och jag
gjorde ett mål . Jag gjorde ett mål
så att målvakten stod vid stolpen
och jag sköt i andra stolpen. (lesson 18)

(The teacher's corrections: Smedsby, gjorde, andra)

Appendix 6. Assessment Report, Case 3, Chris. Translation

Testing 1.

Dates: 30.9, 10.10 1994

Assessment methods: Raven, parts of UMESOL

Assessor: Psychologist Carina Hagkvist

Phonological Awareness

In the sound segmentation task, Chris manages to segment all the words correctly, which means that his segmentation capacity is automated all the way up to phonologically complex words with seven sounds, for example, *stranda* (run ashore).

The Sound synthesis task gives 12 right out of 17 possible, i.e. the synthesis ability is not fully secure. The largest group of errors is omitted sounds, e.g. *blöta* (wet) becomes *böta* (be fined). The errors appear when the words become more phonologically complex, but they do not seem to be dependent on the word length, i.e. not caused by memory constraints.

The position analysis task gives 13 right out of 16 possible. The errors consist of the fact that Chris removes another sound from the word, either before or after the requested sound. He does not insert completely new sounds but sticks to the sounds of the word.

The segment subtraction task is difficult for Chris (4 right out of 15). It is difficult already with removed word parts, *ris* (rice) from *risgrynsgröt* (rice pudding), and regardless of whether the removed part exists at the beginning, middle or end of the word. As a matter of fact, he succeeds best with the most difficult subtask, removing a phoneme from the word, e.g. *ä* from *äta* (eat). This would indicate that Chris has not reached the level of cognitive development necessary for the test, rather than that the synthesis and segmentation skills are not fully automated.

Writing

When writing individual words, Chris gets 23 correct out of 34, which according to Swedish standards is the average level for students with reading and writing difficulties. The error types consist of errors with double consonant, consistently in the direction that single consonant is written as double consonant, for example, *pöl* (puddle) becomes *poll*. Other error types are o-å confusion, *strå* (straw) becomes *stro*, as well as phonetic spelling of non-phonetic words, *högt* (loud) becomes *hökt*. What kind of hand-writing Chris should make use of does not seem to be quite clear, because he alternates between block letters (uppercase and lowercase letters) and script even within a word (eg. STRumPA. sock). After two minutes of training with eight incorrect

words, Chris writes almost all of them correctly, i.e. seven words, which would indicate fast learning of the correct spelling, or that the spelling of these words was actually already quite familiar to Chris.

When writing sentences, Chris mainly uses script, but he sometimes writes block letters (uppercase letters). The result is 30 words correct out of 34 (compare with the average for students with reading and writing difficulties, 23). The error types in sentences also consist of errors with double consonant (written with single consonant this time) e.g. *kommer* (come) will be *komer*, as well as phonetically written non-phonetic words, *häst* (horse) becomes *hest*.

In proofreading, i.e. in finding spelling mistakes in a text, Chris finds surprisingly enough more errors without the answer keys than with the answer keys! He has some orthographic knowledge of how to spell the words. He may also become tired and he may not be so motivated to do the same task twice, which can explain why he misses some spelling errors with the answer keys beside him. He may also have some difficulties in following the lines with his eyes, because he loses a whole line during the check.

Reading

When reading single words, Chris correctly reads 33 words out of 34 with a time limit (20.5 is the average for students with reading and writing difficulties). He uses the orthography strategy and does not need to sound out the words. When reading text, Chris reads quickly and relatively fluently. He does not make any reading errors, but a few times he reads slightly stumbling and repeats a word. Reading comprehension is good (6 correct of 6 possible). When reading reversible words (type *ok*, *mos*) no tendency to read reversals appear. Reading comprehension in silent reading is satisfactory (11 right out of 12 possible). Chris reads quickly and needs no vocalisation to support his reading.

Listening Comprehension Task

In the listening comprehension task, Chris spontaneously tells most of the story, i.e. no general difficulty in understanding language or memory restrictions emerges, but a good ability to understand and retell story structures.

General Cognitive Capacity and Auditory Short-Term Memory

According to Raven, Chris's non-verbal cognitive capacity is at a good average level. In the number series, Chris manages to remember five digits forwards on the second attempt and three digits backwards also on the second attempt. The result (S-score 7) is below the average level (S-score 10).

Testing 2

Dates: 6.3, 13.3 1995

Reading

Reading single words gives 34 correct out of 34 possible. Chris reads the short piece of text quickly and fluently. This time the text comprehension is slightly more inferior than in the last testing: 4 correct out of 6 possible.

Reading of reversible words shows no tendency to read reversals.

Reading comprehension in silent reading is good, 11 correct out of 12 possible. No vocalisation can be seen. Interestingly, Chris gives the wrong answer to the same question as at the first testing (five months earlier). When I ask him to read the sentence aloud, he immediately finds the right answer.

Writing

The word dictation task gives 27 correct out of 34 possible. The error types consist of o-å confusion, double consonant errors and a b-d mix-up.

When writing sentences, Chris managed to write 31 words correctly out of 34 possible. The error types are double consonants in proper names (Olla, Knutt), a phonetically written word and a letter left out. The words that he wrote incorrectly the previous time are now written correctly.

When proofreading, without answer keys, Chris finds 8 spelling errors out of 12 possible. Using answer keys, he found almost all the errors. In comparison to the previous time, his knowledge of how to spell the words has not increased, but Chris is able to make better use of the answer keys this time.

Phonological awareness

Sound segmentation gave a ceiling effect already at the first testing.

Sound synthesis gives 16 correct out of 17 possible, i.e. Chris has improved his performance in this since the first testing.

Position analysis gives 16 correct out of 16 possible, i.e. Chris has improved his performance in this since the first testing.

The segment subtraction task gives 10 correct out of 15 possible, i.e. Chris has also improved his performance in this. Chris manages the phoneme subtraction better than the syllable subtraction, which could indicate that his segmentation and his synthesis skills are not yet fully automated.

Summary

Regarding phonological awareness, Chris has made progress in sound synthesis, position analysis, and segment subtraction since the first testing

(segmentation reached the ceiling effect at the first test). Segment subtraction still seems to be difficult, otherwise the synthesis and segmentation skills are automated.

Decoding and reading comprehension were already good the first time, which is why the test results are not able to show any major changes in the reading ability between the test occasions.

When writing individual words, Chris makes slightly less errors at the second testing. Double consonant errors do not occur as much any longer. Even the non-phonetic words are spelt better than at the first testing. On the contrary, o-å confusions are more frequent than in previous testing.

When writing sentences, the number of misspelt words is the same as at the first testing. Chris manages double consonants except in proper names where he inserts extra consonants, something that did not occur during the first testing. Phonetic spelling of a non-phonetic word occurs once.

The proofreading task does not indicate that Chris's orthographic knowledge of how to spell the words has increased, but he better manages to make use of the answer keys.

Appendix 7. Written Text, Overview of the Work during the Lessons, Case 3.

Lektion 1-2 Introduction, Chris writes single words

hei svej. ha ha alarm pastej vvv. FAN (lesson 1)

Hylla.bord.hi hi. Batteri12345678910 Warning. Mus Kkkkkkkk
1234567890 Tttttttttttt hej (lesson 2)

Lesson 3-4 Chris writes a story about a tree and a wood-man

Det var en gång ett tred som var stort och det trivdes bra. Men en gång kom en skogs-huggare.som tenkte att det var bra ved. (lesson 3)

Han högg ner det och lagade det i bitar. Sen brände han opp det. Sen fanns det inte mer. Sen var sagan slut. (lesson 4)

Lesson 5-11 Chris makes a list of his computer games

Jag har en dator och windows och flera spel. Det besta spelet är doom2. (lesson 5)

Pinball. Jag har flera andra spel.tex. (lesson 6)

,poker,pasians, rolet, shorch, flipper, cc3, doom2, cd-man, gunboat, v-ball,skiordie.

I cd-man skal man plocka bollar och stutsa undan spindlar. (lesson 7)

keen4e, lemmings, I lemmings skall man jelpa lemmings gubbarna. Och i shorch skall man skjuta.pansavagnar. (lesson 8)

Xenon, gp, tetris, titus, vball, puhu., california games2.

I skiordie ska man åka skidor och snoubord och ha snöbollskrig.

Deatrak. (lesson 9)

Aldo, prins of persia, peugeot, golf, coman-comic.

I aldo ska man hoppa over tunnor som rullar, man ska också fara till skatt skistorna och klettra opp för stegar. (lesson 11)

The whole story of computer games (lessons 5-11), the teacher has made some corrections:

Jag har en dator och windows, och flera spel. Det bästa spelet är pinball. Jag har flera andra spel, tex poker, pasians, roulett, shorch, flipper, cc3, doom2, cd-man, gunboat, v-ball, skiordie, keen4e, lemmings, xenon2, gp, tetris, titus, puhu, california games2, deatrak, ducktales, aldo, prins of persia, peugeot, golf, coman-comic, titus the fox.

I lemmings skall man jelpa lemmings-gubbarna. Och i shorch skall man skjuta pansarvagnar. I cd-man skall man plocka bollar och studsa undan spindlar.

I skiordie skall man åka skidor och snowboard och ha snöbollskrig.

I aldo ska man hoppa över tunnor som rullar. Man ska också fara till skattkistorna, och klättra oppför stegar.

Lessons 12 – 14 Chris writes answers to questions which the teacher writes

Lesson 12.

LT: Vad har du gjort på rasten?

C: Jag har lekt.

T: Vad har du lekt?

C: Alt möjligt.

T: Berätta om en sak som du gjort på rasten!

C: Jag har lagat snö bollar.

T: Vem lekte du med?

C: Jag har lekt med Joni M.

T: Berätta hur Joni och du gjorde när ni lagade snöbollar!

C: Han lagade inga snöbol

T: Vad gjorde han då?

C: Han hemtade snö!

T: Vad gjorde ni sen?

C: Vi gick in.

T: Varför gick ni in?

C: Det pipa så klart.

T: Bra Klaus! Du har varit duktig att skriva.

Lesson 13

fem laxar i en ask

packa pappas kapsek!

fem laxar i en ask!

En lax i en tensticks ask!

T: Vad har du sysslat med under helgen?

C: jag har varit hos minfammo och faffa.

T: Berätta vad du gjorde där!

C: leste!

T: Berätta va du läste?

C: serie tiningar.:

Äppel päppel piron päron puff

Krockan satt på en kvist.

Åpåpåpåpåpåppopo

Lesson 14.

-----!!"#&&&/()=?

T: Berätta om rasten!

C: Jag lekte kissa.
T: Berätta mera!
C: Jag lekte kissa med joni&janne&joniV&jarno
T: Hur gick det till?
C: Bra!
T: Jag menade: vad hände? Hur gjorde ni?
C: Man skulle springa efter nån.

Lessons 15 – 19. Chris writes about his pets

Lesson 15

vi har en katt & några fiskar
katten är halv angora. den har bara varit i djur doktorn en gång.den är svart & vitt. Den sover på dagarna. den heter Ludde. han är pojke.

Lesson 16

Fiskarnas märkeär:rubin.barbi Man får inte glöma att mata dem & tvätta akvariet

Lesson 17

Men man ska inte ge dem för mycket mat! För då äter dom igel sig.

Lesson 18

neor. Neor är den största fisken vi har.

All the text in lesson 18

vi har en katt & några fiskar.
katten är halv angora.
den har bara varit i djur doktorn en gång.den är svart & vitt. den sover på dagarna. den heter Ludde han är pojke.
Fiskarnas märkeär:rubin.barbi.neor.
neor är den största fisken vi har.
man får inte glöma att mata dem. men man ska inte ge dem för mycket mat!! för då äter dom i gel sig. Man skall inte glöma att tvätta akvariet.

The text with the teacher's corrections

vi har en katt & några fiskar.
katten är halv angora.
den har bara varit hos djur doktorn en gång.den är svart & vit. den sover på dagarna. den heter Ludde han är pojke.
Fiskarnas märke är:rubin,barbi.
neor. neor är den största fisken vi har.man får inte glömma att mata dem. men man skall inte ge dem för mycket mat!! för då äter dom ihjäl sig. man skall inte glömma att tvätta akvariet

Lesson 19. Chris removed the passage about neor.

Version 1. The teacher and Chris have discussed upper-case letters

Vår katt & våra fiskar
Vi har en katt & några fiskar.

Version 2. The teacher said: "Capital letter after a full stop"

Vår katt & våra fiskar
Vi har en katt & några fiskar.

Katten är halv angora.
Den har bara varit hos djur doktorn
En gång.den är svart & vit. den
Sover på dagarna. den heter Ludde
Han är pojke.
Fiskarnas märke är:rubin.barbi.
Man får inte glömma att mata dem.
Men man skall inte ge dem för
Mycket mat!! För då äter dom ihjäl
Sig. Man skall inte glömma att
tvätta akvariet.

Katten är halv angora.
Den har bara varit hos djur doktorn
en gång. Den är svart & vit. Den
sover på dagarna. Den heter Ludde
Han är pojke.
Fiskarnas märke är:rubin, barbi.
Man får inte glömma att mata dem.
Men man ska inte ge dem för
mycket mat!! För då äter dom ihjäl
Sig. Man skall inte glömma att
tvätta akvariet.

Lesson 20 Chris writes about New Year's Eve

. Nyårsafton
.Vi for till fiskstranden klockan 8
och skuta raketer och bomber.
Raketernas och bombernas namn var:
romerska ljus & chinare, mattare,
katt fis raketer,och stora raketer
och en panssar vagn som rör sig
och smeller av

Lessons 21, 22 Ove training programs

Lessons 23 – 24 Chris writes answers to questions which the teacher writes

T: Vad gjorde du igår?
C: spelade.
T: Vad spelade du?
C: spear of destiny och lemmings
T: Berätta om spelen!
C: i spear of destiny skall man akta
sig för gubbar och skjuta
gubbar. Och i lemmings skall man
göra att gubbarna far till boet.

Lessons 25 -26 Chris writes about a visit to an amusement park

Tammerfors

Vi skall resa till Tammerfors. Vi
skall besöka näsineula, mumindalen
och delfinriet. (lesson 25)

först for vi till mumindalen, och
Delfinriet, och till sist for vi
till Näsineula.

i mumindalen tittade vi på tavlor.

I delfinriet tittade vi på
delfiner som gjorde konst.

Sen for vi till Näsineula.

och där tittade vi omkring neråt.

Sen for vi till Näsineulas
resteurang. Den snurrade runt.

Sen for vi hem. Det var roligt!

(lesson 26)

Appendix 8. Assessment Report, Case 4, John. Translation

Testing 1.

Dates: 3.10, 9.10, 18.11 1994

Assessment methods: Raven, parts of UMESOL

Assessor: Psychologist Carina Hagkvist

Phonological Awareness

The Sound synthesis task gives 9 correct out of 17 possible, i.e. the synthesis ability is not fully automated. The errors appear with the phonologically complex words. It seems that they would depend on memory limitations, because John omits the beginning of the word, *skrot* (scrap) becomes *rot* (*root*) and *blaska* (splash) becomes *aska* (ash).

Sound segmentation is fully automated up to seven-sound phonologically complex words (17 correct out of 17 possible).

The position analysis task gives 12 right out of 16 possible. John makes errors confusing before and after. For example, he mentions the sound /l/ when I ask what sound is before /o/ in *polis* (police). The reason may be a lack of concentration or uncertainty in terms of the sequence of the stream of sounds. The segment subtraction task gives 8 right out of 16 possible. Subtracting syllables within a word or individual sounds is still difficult for John. He has more than two errors in the last part (sound segmentation), which means that he has not yet reached the cognitive level of development necessary for the task.

Writing

When writing individual words, the result is 25 correct out of 34 (the average level for students with reading and writing difficulties is 24). The error types are confusion with o/å, phonetic spelling of non-phonetic words and omitted letters, e.g. *hjälp* (help) is written *hjl*.

John uses script and has a neat handwriting. After two minutes of training with the incorrect words, John writes 6 correctly out of seven possible, which indicates fast learning of the correct spelling, at least in the short term.

When writing sentences, the result is 28 words correct out of 34 words. The error types consist of errors with double consonant (*flickan* (the girl) becomes *flikan*), confusion with o/å and a confusion with b/p.

In finding spelling mistakes in a text, John finds 5 errors of 12 possible errors without the answer keys, which indicates that he does not yet have clear orthographic knowledge of how to spell the words. Using the answer keys, John

finds almost all errors, 11 out of 12 errors, which indicates that visual comparison and differentiation are not difficult for him.

Listening Comprehension

The listening comprehension task gives 10 spontaneously reproduced moments (the average for students with reading and writing difficulties is 12). John remembers the most essential features of the story. No shortcomings in general language comprehension.

Reading

When reading reversible words, no tendency to read reversals appear for John. When reading single words, John correctly reads 31 words out of 34 with a time limit. The occasional reading errors consist of an omitted letter, doubled consonant and confusion between visually similar letters.

When reading text, John reads relatively fluently with some repetitions and few reading errors: lost letter and lost word. Reading comprehension is good, 5 correct out of 6 possible.

Reading comprehension in silent reading is good, 12 correct out of 12 possible. Periodically, supporting lip movements are visible.

General Cognitive Capacity and Auditory Short-Term Memory

According to Raven, general cognitive capacity well above the average level, i.e. level 2. Auditory short-term memory according to Digit Span on an average level.

Testing 2

Dates: 20.2, 6.3 1995

Writing

We write the words that John wrote incorrectly at the first testing as well as some of the longest, phonologically most complex words, e.g. *tröskel* (threshold). The result is 31 correct out of 34 (if the words, which were correctly written at the previous testing, are included). Except a small careless mistake, which he corrected, John now manages to spell the non-phonetic words correctly (*kom* (came), *arg* (angry), *högt* (highly), *också* (also) and *hjälp* (help)). The remaining errors are confusion with å-o, for example in *måla* (paint) which is written *mola*.

When writing the sentences where errors emerged in the previous testing, the result is 30 correct out of 34 possible. In addition to a small careless error that

emerges, errors with double consonant and an error with o-å confusion still occur.

When proofreading, without answer keys, John finds 9 spelling errors out of 12 possible. Using answer keys, he finds 11 errors, i.e. one of the errors is omitted.

Phonological awareness

We make the synthesis of the words which went wrong in the previous testing. The result is now 6 correct out of 7 possible. John sometimes needs to hear the sounds twice, but otherwise, he manages well to do the synthesis, also the phonologically complex words.

Sound segmentation gave a ceiling effect already at the first testing, so we do no re-testing of that part.

Position analysis gives 13 correct out of 16 possible. It is interesting to notice that Joni makes mistakes in the same tasks as at previous testing: he mentions a sound *after* instead of *before* or later in the stream of sounds.

The segment subtraction task gives 9 correct out of 15 possible. Compared to the first testing, John now manages almost all tasks on the phoneme level, but he is less successful in tasks with subtraction of syllables. According to the manual, the fact that he manages the phoneme subtraction better than the syllable subtraction can indicate that his segmentation and his synthesis skills are not yet fully automated.

Reading

Reading single words, John reads 32 words correctly out of 34 possible, with time limit. A reversal of letters occurs, *skarpa* (sharp) becomes *skrapa* (scratch).

Reading text, John reads relatively fluently without reading errors and with few repetitions. Reading comprehension is good, 5 correct out of 6 possible.

Reading reversible words, no tendency to read reversals occurs.

Reading comprehension in silent reading is good, 12 correct out of 12 possible.

Supporting whispers, lip movements occurs periodically.

Summary

Regarding phonological awareness, John has made progress in sound synthesis since the first testing. The results in the position analysis and in the segment subtraction are approximately at the same level. Segmentation reached the ceiling effect already at the first testing.

Decoding and reading comprehension were already good at the first testing, so it is not possible to find any major changes in the reading skills using the test Umesol.

When writing individual words, John spells them better now than at the second testing. Now, he manages to write especially the non-phonetic words correctly. Confusion with o-å remain. Errors with double consonant in words where it is not required did not occur, neither in the first nor in the second testing.

When writing sentences, the number of misspelt words has diminished. On the contrary, only one error type, b-p confusion, has disappeared. Errors with double consonant (2 out of 3) and a confusion with o-å persist. The proofreading indicates that John now know more about how the words are spelt than at the first testing.

Appendix 9. Written texts, overview of the work during the lessons, Case 4

Lesson 2-3 About Annika

Lesson 2: first version

grabb erik.rap !

annika kommer fronskolan snart. Då kan hon gå ut och tjöpa gardemumma och ta Ruff med sig. Hej mamma och pappa.

Lesson 3. Final version

Annika kommer från skolan snart. Då kan hon gå ut och köpa kardemumma och ta Ruff med sig.

Hej mamma och pappa! Jag ska gå och köpa kardemumma.

Men va bra då kan du ta Ruff med dig.

ok.

Slut.

Lektion 4 - 8. A story about a dragon and a knight

(lesson 4)

Den hemske draken.

Det var en gong en hemske drake som satte eld på varje stele.

(lesson 5, correction)

Det var en gång en hemske drake som satte eld på varje ställe.

En riddare skulle strida mot den hemske draken. Riddaren gav sig av.

- - - Jag är på ett farligt ställe.

Plötsligt hoppade 4 män på honom.

(lesson 6)

Riddaren sparkade på en av mänen men det hjälpte inte. De 4 mänen kastade riddaren i sjön. Riddaren spolades opp vid draken just när draken tänkte spruta eld på kungens borg. Riddaren kastade sitt svärd på draken.

(lesson 8)

Men vad nu. Draken steg upp och var blå. Draken bröt av svärdet. Draken sprutade på riddaren. Riddaren kastade kniven. SPPLATTC. Riddaren föll ner i sjön och klarade sig. Slut.

Lessons 9 -14 Ove exercise programs with double consonant

Lessons 15 - 19

A story about a very clever hedgehog and a fox

(lesson 15)

Igelkotten och Råven.
En gong gick en Igelkott på en

stig. P

(lesson 16)

Plötsligt hoppade en räv
fram.

- Kan du komma till mig, sa råven.

- Nej,sa igel-kotten.

vad heter du, sa råven.

<,sa igelkotten.

- kan jag komma till dig, sa råven.

-nej , sa <.

Råven sprang vidare <fortsatte
sin vandring.

(lesson 17)

Plötsligt hörde <

ett yl. < gick dit och såg råven

död! < vände sig. Råven hoppade på

igelkotten och fick taggar på

nosen. Slut.

(lesson 18, corrected)

Igelkotten och Råven.
En gång gick en Igelkott på en

stig. Plötsligt hoppade en räv
fram.

- Kan du komma till mig, sa råven.

- Nej, sa igelkotten.

- Vad heter du, sa råven.

- <,sa igelkotten.

- Kan jag komma till dig, sa råven.

- Nej ,sa <.

Råven sprang vidare < fortsatte
sin vandring. Plötsligt hörde <

ett yl. < gick dit och såg råven

död! < vände sig. Råven hoppade på

igelkotten och fick taggar på

nosen. Slut.

(lesson 19: outprint)

Lessons 20 - 24

The Fulmar Patrol rescues a train

Stormfåglar.

Ett tåg skulle tjöra över trasig
bro under bron fans det vatten

(corrections)

Ett tåg skulle köra över en trasig
bro under bron fans det vatten.

Bron gick sönder och tåget föll i
vattnet tågstationen fick reda på

att tåget har fallit. Tågstationen
ringde 113.

-stormfåglar, svarade Scott, en av
stormfågelpatrullen.

- Här är tågstationen, sa
direktören.

-Vi kommer, sa Scott. Stormfågel 2

(lesson 20)

(lesson 21)

(lesson 22)

låda4. I låda4 fans det
stårmfågel4.

correction:
stormfågel

SLÄPP!lådan>3"2"1"0"nu.

- Vi skall knuffa upp tåget, sa
GORDON. Ok Iq.

(lesson 23)

- Men vi har bara 2 minuter på
oss, sa en av passagerarna.

Vi hinner,sa Virgil.

(lesson 24: outprint)

Lessons 25 – 27

The Fulmar Patrol rescues a space rocket

5"4"3"2"1" här är Stormfåglar. Mot
solen.

(lesson 25)

Staden New york hade gjort en
raket som hette:Sol raketen.

- 10sekunder för start.

10"9"8"7"6"5"4"3"2"1"0

- Senaste nytt från oss, sa
nyheterna.

(lesson 26)

- Sol raketen har farit mot solen
och kan inte vända,sa nyheterna.

- Scott, Alan och Tintin gå och
försök rädda sol raketen. Virgil
och Brains ta kapsel 6.

(lesson 27)

- Vi skall skicka en signal
pappa, sa Alan. Men i sol raketen
var det väldigt varmt!

- Singnalen lyckades, sa Scott.

- Alan starta raket motorerna.

I sol raketen sa en gubbe: det
ljudet. Raket motorerna har
startat. Vi kommer att över
leva!!!!

Men i stormfågel 3 kan inte
vända.Brains och virgil fick reda
på det.

- Brains vad skall vi göra?

Vi har också singnaler, sa Brains.

Singnalen lyckades.SLUT!!!!

