Reinventing Papert's Constructionism - Boosting Young Children's Writing Skills with e-Learning Designed for Dyslexics

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Abstract: Since the consent to the Salamanca Statement on special needs education from 1994, e-learning developers have focused on tools aimed to support dyslexic learners. The importance of these efforts is on display every year in the Special Aids exhibition area at the BETT-event in London. ICT and e-learning is now widely used in the special needs education for dyslexics. However, the Salamanca Statement also inspired the vision of *The Spacious School* and the idea that children with learning disabilities should be transferred from special classes and included in the ordinary classes in primary schools. In the beginning of this process, the children with special needs were present in the classroom with their compensational aid, e.g. e-learning, ICT and special teacher support, and they were rarely included in the socially organised learning activities. Consequently, class teachers and subject teachers were not aware of the existence and potentials of the special compensational e-learning and ICT tools.

In recent years in Denmark, ICT has changed from being present in schools to becoming an available, everyday resource. That is, ICT and computers move out of the computer rooms and into every school room. I.e. most pupils use ICT, e-learning and computers in various contexts whenever it seems convenient. The increasing use of ICT in schools has paved the way for new ways of including the children with special educational needs and while knowledge of dyslexic compensational e-learning and ICT tools was earlier restricted to the special teachers, teachers in general have now become aware of the existence of these tools. Within the frame of a large scale research project in primary schools in Denmark (Project IT and Learning – PIL), this change of awareness led to teacher-initiated experiments with the Danish e-learning special needs-software *CD Ord* in first and second grades. The teachers wanted to see whether these tools could inspire normal children as well as children with special educational needs to start writing their own stories.

The paper presents the research findings from the empirical studies of experiments in Second grade. The paper concludes that most children in the experiments wrote longer and more complex stories than normally expected from this age-group. The children with a visual learning style in particular demonstrated a significant progress.

Keywords: e-learning, writing skills, reading skills, storytelling, dyslexics, special needs, constructionism

1. Introduction or background

From 2002-2004, the Danish Ministry of Education (UVM) supported a large-scale research- and development project on cross-country implementation of ICT in Danish primary schools called ITMF. In Gentofte – a suburb of Copenhagen – two primary schools were chosen for the ITMF project. As a follow-up on these local projects, Gentofte municipality initiated *Project IT Learning (PIL)* in order to root the results from ITMF and disseminate and apply them to the other schools in the municipality. Further, PIL was to initiate new research- and development projects in collaboration with the *Danish School of Education* (DPU). Where ITMF focused on implementation of ICT in general, PIL focused on ICT in relation to subject knowledge and competences. PIL's objective was to create knowledge on how ICT possesses particular qualities that can contribute to constitute relations between subject knowledge, learning and ICT in new ways that enhance learning (Levinsen & Sørensen 2008).

The project involved subject-related research- and development of:

- Danish as first language and ICT/e-learning
- Language and ICT/e-learning: English and French
- Nature/Science and ICT/e-learning: Physics, Chemistry and Nature/Science

Further, the project defined special areas of interest for research and development:

- Pedagogic knowledge management
- Interactive whiteboards
- Special needs education: CD Ord

Within these areas, teachers developed model-projects based on their own practice and context. The research was carried out as a combination of anthropological and action research methods.

The ITMF findings pointed at positive relations between the writing process, ICT, and learning. It was found that multi-modality allows for a variety of means of expression which seem to support the consistency of the children's writing. These findings relate to form, content, vocabulary and repertoire of styles. Therefore, the PIL Danish-as-first-language model-projects focused on ICT as a motivating and supporting factor in relation to writing. The ITMF project also featured projects testing the so-called IT-backpack for dyslectic children (Levinsen 2007). Here it was found that the backpack - a laptop PC, scanner, scanner-pen, headset and compensational software -, helped integrate dyslectic children in normal classes. Especially the application *CD Ord* promised potential ("Ord" is Danish for "word"). In PIL, CD Ord model-projects took outset in exploiting CD Ord's speech synthesizer as an intrusive compensation addressing the child's receptive language skills: listening and reading. However, a consequence of the extensive ITMF effort is that ICT has become an available, everyday resource in Danish primary schools and accordingly, we observe an increase of general knowledge of ICT's pedagogic potentials among school teachers. Additionally, children with special needs are included in normal classes with their compensational ICT-tools and therefore class teachers become aware of these specific tools. For PIL, this development led to an unpredicted convergence between the originally separate model-projects in *Danish-as-first-language-teaching* and *CD Ord projects*. Some Danish-teachers initiated experiments on their own using CD Ord in first and second grades. The teachers wanted to see whether the tool could inspire normal children to start writing their own narratives. These experiments are the subject of the current paper.

2. Danish subject objectives

According to UVM (UVM Shared Objectives 2008), the aim of Danish teaching in primary schools is to promote the pupils experience of language as a source for personal and cultural identity development based on aesthetic, ethical and historic understanding. The teaching supports the pupils' inclination to use language communicatively in a personal and all-round fashion. The education improves the pupils' awareness of language and their development of an open and analytical attitude towards present and historic styles of expression. Pupils achieve enjoyment of reading and writing and increase their engagement with literature. As a subject, Danish encompasses both general education and subject objectives. The subject objectives include receptive, productive and literary competencies.

In relation to the first and second grades, the specific objectives of relevance to PIL are (UVM Stage Objectives 2008):

▪ *Spoken language*: The ability to make conversation, to collaborate and present subject matters, to know expression styles within different genres as story and fairytale, and the ability to identify and discuss basic narrative elements.

▪ *Written language – writing:* The ability to write simple fiction in different genres as story and fairytale based on personal experiences, imagination or other texts, to know basic semantics and to achieve basic computer literacy.

These objectives are to be met during the first two years of primary school and they are assessed at the end of second grade. As the experiments took place early in second grade, the children in the current cases had not yet achieved the objectives.

3. CD Ord

CD Ord is a compensational aid for anyone with severe reading and spelling disabilities. The application is produced by the Danish company *Mikro Værkstedet* (http://www.mikrov.dk/). The tools are intuitive and easy to use, even for small children. There is an interface for control of text recitation (figure 1 a) and an interface for word-suggestions (figure 1 b).

All digital (e.g. MS Word, homepages) and OCR-scannable text (Optical Character Recognition) can be read aloud by the speech synthesizer, using the voice *Carsten* (a typical Danish male name). Carsten is good at reading coherent text, e.g. stories, news paper articles or web pages. Carsten is fluent, but lacks intonation and makes occasional mispronunciations. For shorter sequences or separate words, CD Ord offers natural speech. This voice has perfect pronunciation and varies the intonation according to context. The natural voice is not suitable for longer passages because it becomes monotone. The application offers settings for various reading strategies and stages of development of the users reading skills. Among other features, CD Ord's word list offers alternative and contextualized word suggestions along with homophone words. When the user performs a mouse-over, the words are read aloud. The alternative suggestions help users who have difficulties with the beginning of words or with the transformation of sound into letters.
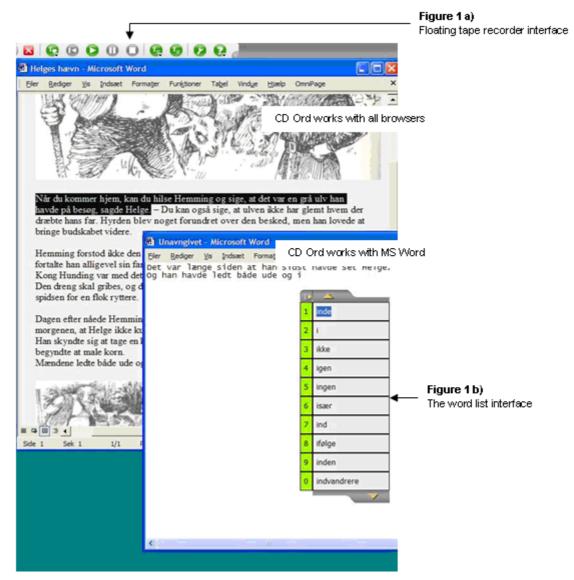
Figure 1a)
Floating tape recorder interface

CD Ord works with all browsers

CD Ord works with MS Word

Figure 1b)
The word list interface

Figure 1: The CD Ord interface (a & b) in relation to browsers and MS Word

4. The cases

Literacy and an inclination to write presuppose something to write about, and the writers' ability to produce a coherent narrative structure. Therefore, the Danish- and ITC model-projects combined the writing process and the children's own production of stories. The ICT-tools used in the projects offered interaction with images, writing and sound/speech for production of audio-visual products, e.g. PowerPoint- or PhotoStory presentations. ICT and especially working with images were seen as catalysts for the children's creative process. The principles of the linear narrative and genres were introduced before the children began to work on their own.

Several Danish teachers saw the potential in CD Ord and chose to use the application in ordinary Danish-teaching in the first and second grades. The idea was that easy access to word lists and speech generation may fuel the children's inclination to write their own stories. The teachers were inspired by constructivist and experience based learning principles (Kolb 1984, Själsö 2000, Illeris 2006) and recommendations from recent research (Frost 2000, Trageton 2004, Elbro 2006, Bjerre 2007). On this basis, they wanted to apply CD Ord's ability to address the children's productive language competencies: speech and writing. Additionally, CD Ord allows users to select their favourite learning approach (Rasmussen 2006). Consequently, the young children may construct narratives using their preferred strategy, based on their established competencies. The teachers also draw on social learning principles, as the children in the current cases either work in pairs or communicate freely with each other during the sessions (Jessen 2001, Illeris 2006)., while constructing ad hoc Communities of Practice (Wenger 1998).

The teaching took place in the early autumn of 2006 and the children had just started second grade. Together, the two classes comprised some forty pupils. The empirical data was produced though participatory observation (Hasse 2002, Hastrup 1999) and documented though *Thick Description* (Geertz 1973). All the pupils were observed but as the research is qualitative, the case presentation and the findings refer to two specific examples for the sake of clarity.

4.1 Thrills and horror in second grade

In this school, children have easy everyday access to computers. The children are fascinated by the horror genre and they understand the basics of constructing narratives. However, they find it difficult to write comprehensive action and their construction of suspense is without tension. The children work in pairs writing horror stories using MS Word and CD Ord. The teacher has produced a library of horror sounds in advance. As the children have no previous experience with digital sound, the teacher expects the sounds to serve as an external motivator. The project's duration is three weeks, and the children work concentrated on the computer one hour each week. In between, they work with other approaches to storytelling.

The boys Asmus and Filip are paired by the teacher because Asmus is 'visual' and has a vivid imagination, but is easily distracted. In contrast, Filip is careful and literate, but unimaginative. They are both good with computers and on the first day they bring their handwritten principles of narrative structure and start the PC on their own. They find the teacher's sound library on the memory stick and activate the sounds – a creaking door, a ringing bell. The creaking door is spooky and Asmus begins to fabricate a story. The teacher asks if there is anything missing in the story. Filip suggests somebody evil and Asmus suggest a living scarecrow who wants revenge. Asmus emphasize that the audience must not know right away, as suspense makes the story more exiting. Due to their different learning styles, it is not easy for them to start writing. Asmus got the story in his head, but does not want to write and when Filip writes, he corrects mistakes all the time and Asmus gets distracted while he waits. On the first day, they write two lines of the story. During the week, the teacher helps them write cue words and an outline for the story on paper. They found the teacher's sounds boring, and have produced a list of sounds on their own: *fire, laser guns,* and *exultation* when the living pumpkins die. After half an hour, they have written 12 lines and Filip sits at the keyboard while Asmus wears the headset. Filip wants to write 'looked', but writes 'loked'. He puts the cursor between o and k – 'lo|ked' - which causes CD Ord's list to display words beginning with 'load'. Filip moves the cursor over the list while Asmus listens and Asmus quickly understands that this list is of no help. Filip moves the cursor between k and e – 'lok|ed' – and now the list displays words with two o's. Filip roll over the list while Asmus listens. Even before Filip reaches 'looked', Asmus points at the right word. Filip clicks on the word, and it appears in the story. On the third day, the boys fetch the headset, memory stick and their manuscript and start off with Filip at the keyboard. Filip writes 'sombi' and CD Ord list 'som'-words. Something is wrong, and the teacher asks if the word could begin with another letter. "Z!" they shout in unison. Filip writes 'Z', and 'Zombie' appears in the list. Asmus explains that the 'e' in the end is because the word is English. Now the story goes: "… an army of zombie pumpkins …". Gradually, the boys begin to negotiate change of vocals, first letters and endings by combining memories with suggestions in the list and Carsten's reading aloud. Later, when Asmus is at the keyboard, he remembers that 'Zombie' begins with 'Z'. However, he forgets the 'e' in the end, even though he knew it earlier. Asmus has difficulties with words' endings. Many negotiations and lines later, the Zombie army is defeated with laser guns and this must be celebrated in the story. Filip writes 'cake and soder water'. Asmus says: "sodor". Together they look in the list and Filip moves the cursor. Asmus becomes exited: "There it is – 'soda water'!! – it's 'soDA' water". This is the end of the story and they let Carsten read it aloud to check the narrative as a whole.

4.2 Second grade continues the teacher's story

In this school, the children have limited access to ICT and computers. In the first grade, they had basic ICT literacy and they know how to log in and write messages; they know MS Word and understand the basics of CD Word. The teacher wants to test whether CD Ord and MS Word are useful catalysts for storytelling, writing and spelling. The class has worked with storytelling before the day in the computer room. The teacher told an exiting story, but stopped at a cliff-hanger, and the children continued the story by fabricating, drawing and writing a draft by hand. Today they are to write their stories on the computers. The class is divided in two groups because of the limited size of the computer room. The pupils are sorted by gender, because the boys are more mature and computer-literate than the girls. The computer room is booked for two hours for each group. There are nine girls in the group and as soon as they enter the computer room they start on their own: log on, MS Word, CD Ord, and begin to write from the draft. They are exited about

the headsets and the voice generator. The girls work in pairs but three girls work alone as their partner is missing due to illness. Two teachers function as consultants and help the children when necessary.

Alice and Sophie begins their story: "A wonderful summer ...". They write letters and immediately find the word in CD Ord's list when Carsten reads aloud. They share the headset and soon they drift off into listening to unfamiliar words: "social democracy". "That's the workers" says Alice and laugh. Sophie figures out how to generate compound nouns in the list. In Danish, compound nouns are one word where in English they stay separate, e.g. English: *summer day* and Danish: *summerday* Sophie finds out that if she double-clicks at the word "summer" in the list, the list displays compound nouns. They need "summerday" for the story and Sophie tells Alice to correct "summer day" into "summerday". Afterwards she tells the other girls how to use her discovery.

Oline works alone. During the preparation, where they were supposed to write drafts, she has written nothing at all and the teacher is a bit worried. In general it is difficult to persuade Oline to write. However, she has produced some very fine drawings – a cartoon draft. Oline starts the computer and apparently she just fiddle aimlessly about. Suddenly she seems to catch the principle of finding words in the list. After half an hour she leaves the story she had planned in her cartoon draft and begins to fabricate and write directly out of her head. At one point she wants to write "play" but writes "doctor" (In Danish *play* is "lege" while *doctor* is "læge"). When she listens to her story, it obviously sounds wrong. The teacher suggests that she think of other letters than "æ" that may sound more right and she finds the right word "lege". Later, she needs a doctor in the story and this time she does not even use the list. She also construct complex words as "emergency room" and "ambulance service" in various inflections by combining spoken language with writing and listening to her own writings as well as the list. She manages to write about 400 words of formidable story.

5. Findings in relation to Danish subject learning objectives

5.1.1 Thrills and horror

When Asmus and Filip work on their story, they point at the screen and compare sentences in one part of the text with sentences in other parts. They draw lines in the air in front of the screen while talking. This is possible because the text is externalized and thus easier to share and negotiate. E.g. Asmus and Filip have a long discussion on how their heroes - a farmer and his two sons - are to fight against the revengeful scarecrow's army of zombie pumpkins. The horror genre conventions prescribe that suspense is build up though three phases. Now the boys are aware that their three events are alike – they must be different as Asmus says "… or it will be boring". The list also inspires varied negotiations on content and form, as the boys become aware of their redundant use of words and start to search for synonyms. From day one to day three, Asmus and Fillip displays an evident change of language awareness and they develop an analytical attitude towards the horror genres styles and means of expression.

As they worked together, Asmus becomes more concentrated and focused and Filip becomes more free and imaginative. In the beginning, Filip notice the prescriptive error that the story misses an evil character. When Asmus suggests the revengeful scarecrow, Filip begins to define a scarecrow: "A scarecrow frightens the birds away from the strawberries". Then Asmus gives Filip a lesson in storytelling: "When the farmer was a boy he accidentally pushed someone over the cliff. He died. It's his spirit – his soul – inside the scarecrow. It wants revenge … Kill the farmer". On the last day Filip shows that he has become more free as he wants to end the story: "And then they cheered and now they are going to drink a pint of beer". In return, Filip's insistence on correct spelling helps Asmus to confront the endings that causes him so much trouble (in Danish the ending of a word, equals English "the", e.g. Danish: "en hær", "hær*en*" and English: "an army", "*the* army"). Reluctantly he begins to be more careful:

Filip: "You wrote 'hær' - It has to be 'hæren'"

Filip: " You wrote 'fant'"

Asmus corrects to 'fan<u>d</u>t' without using the word list and writes on.

Filip:" you have to write 'laser sword'"

Asmus insists that he spelled it correctly, but he has written 'lyser sword'.

Filip: "it says 'lyser'"

Asmus corrects: "No it says 'laser'"

… and a little while later …

Filip: "it has to be 'laser light'"

Asmus: " THAT'S WHAT IT SAYS!!!!!!!!!!!!"

He reads again ... "well, no" … and corrects the error.

In the end, Filip is writing and Asmus shows that he actually wants to care about the spelling. Filip has written "cookies and *soder* water". Asmus can see the mistake because MS Word redlines spelling errors, and he suggests: "It's 'sodor'". Then they both look at CD Ord's list. Filip makes a roll-over and Asmus yells: "There it is! It's 'soda water', it's called soDA water!". The soda water sequence is also a fine example of how the list and the recitation function interact with the children's spoken language. None of them knew how to spell 'soda water'. Filip began by saying the word very slow and constructed the right beginning: "sod". This was enough for the list to generate useful suggestions. By listening to the recitation they noticed the right spelling, which Asmus emphasised by saying "soDA water!". In the last hour of writing they often use this approach, either because the story needs a certain word or because they want to vary the language, e.g. laser light, light laser, army of zombie pumpkins or pumpkin zombie army.

5.1.2 Second grade continue the teachers story

Except for Oline, all the girls have handwritten a draft and they begin to copy the draft word for word into a MS Word document. When they notice the red error marking they listen to the words in the list and import the right word to the story. This procedure is very slow, because most of the girls cannot remember the keyboard and also lack basic ICT-skills such as the double click, delete, forced- and auto-carriage return etc. When they want to change a word, they use back space and remove the whole word or even a whole sentence, before they rewrite all over. Consequently, they are easily distracted by CD Ord as a kind of word game. They begin to write letters in MS Word, in order to see what the list generates and then they explore strange and funny looking words. Apart from Alice and Sophie who discovered how to generate compound nouns in the list, and Oline who fiddles about, the progress of the stories is rather slow during the first session (45 min.). This demonstrates that copying from a draft is no big challenge, but that the lack of basic keyboard-skills may be a barrier. Also, copying does not appear to be a very good exercise, if the objective is to train computer literacy or storytelling. So, the girls drift off into exploring the word list in CD Ord. However, the session in the computer room is two hours long, and gradually something changes. The girls listen to the recitation and realize that their stories are boring and begin to negotiate the problem. Gradually, they move from exploring words at random to improve their story by adding new ideas and finding synonyms. However, the stories are no longer than 10 sentences (50-90 words).

Oline is working quite differently. She has produced a kind of cartoon that reproduces the teacher's story up to the cliff-hanger. She spends a long time apparently clicking stuff at random in CD Ord. When she starts writing, she transforms the cartoon into words – it is a story about two siblings who play together. The little brother teases his sister and she ends up knocking his head with her clog. It is early in this sequence that she needs the word for play 'lege' but writes the word for doctor 'læge'. When she realizes something is wrong and she gets stuck, she asks the teacher for help. The teacher asks: "Do you know what the word 'læge' means?". "That is someone who operates sick people" Oline replies. Then they talk about changing letters/sounds and she understands the change of *æ* to *e.* From this point on, she has no problem swapping vowels and soon she gets to the end of the cartoon draft. After half an hour she begins to fabricate freely. The little brother's wound is getting serious and now Oline needs a doctor in the story. She remembers the spelling without using the list. When the doctor arrives in the story he needs the ambulance service and the little brother must be taken to the emergency room at the hospital. When the session is over, Oline has written half a page – a dramatic and action packed narrative with many difficult words and a fairly complex syntax.

6. Conclusion

CD Ord was originally designed as a compensational tool for dyslexics. However, the cases demonstrate that the use of CD Ord as an interactive e-learning application in ordinary classes makes good sense. In both cases, children who have just begun second grade approach or surpass the learning objective for the end of second grade.

The children developed a method of using their productive language competencies together with CD Ord as an interactive sparring partner and were able to construct the desired words for their stories. They experimented and listened to the recitation of the word list and their own writings. In both cases the use of the list changed during the sessions. In the beginning the children used CD Ord to control spelling and they preferred to find the word in the list rather than write it themselves. Gradually, they began to construct more

complex words and use the text list as an interactive and explorative tool. At the end of the sessions, most children – and especially the children in the described cases – had changed the way they used the list. Now they only searched for new words after they had negotiated the structure and the progress of the stories. The amount and complexity of words they could spell directly without the use of CD Ord increased remarkably during the writing sessions along with grammar skills, e.g. correct inflection and endings. Apparently the shared, externalised text on the computer screen, along with the audio feedback from CD Ord and the visual error-feedback from MS Word function as a catalyst for the growing urge to produce a good story. Asmus and Filip, who fabricated their own horror story, ended up negotiating the attributes and presentation of their characters, how to build suspense, and how to vary the language. Oline, who surpassed the content of her cartoon draft, worked with the text on a higher level. She regularly listened to Carsten's recitation of her story and made changes that enhanced the momentum and suspense of her story.

In conclusion, the application of CD Ord as interactive e-learning in ordinary classes is successful. However, Oline and Asmus are especially interesting as they both had a preference for visual and verbal expressions, and both had tried to avoid writing. Before the CD Ord sessions, both teachers were worried about the children's attitude towards writing, but after the sessions Asmus' teacher was very confident, while Oline's teacher was rather taken aback by Oline's achievement. In this sense the pedagogic setup displays strong simularities to Seymour Papert's Constructivism (Papert 1980, Papert 2000), while both Oline and Asmus resembles Papert and Turckle's (1990) description of the bricoleur approach to learning.

The cases represent only a limited set of data, which cannot alone support wider conclusions. However, the cases were fundamentally different; both in context and setup's, and their only shared features were the specific use of CD Ord and certain pupils' reluctant approach to writing and their vast progress. A large body of studies confirm the learning effect of contructionist pedagogic design and therefore it seems reasonable to claim that the cases demonstrate the potential of interactive e-learning in relation to pedagogic design and support of varying learning preferences and learning difficulties.

Acknowledgements

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