



DESIGNS FOR LEARNING

Vol. 7 / No. 1

Designs for Learning
Volume 7 / Number 1
2014

Talking Books in Reading Instruction and Student Behavior

STIG T. GISSEL, University College Lillebaelt &
University of Southern Denmark, Denmark

In grade 1, Danish students used a talking book with TTS (text-to-speech) and participated in a learning design with emphasis on decoding and reading for meaning in written text. The students all read the same unfamiliar text, which for many of the students would traditionally be considered being at their frustration level. Basing the intervention on connectionist theory of reading and Share's self-teaching hypothesis, students were instructed to try to read the words before activating the TTS-function.

Only five students out of 17 used the software in ways that could promote self-teaching, but underused the support. Five other students very quickly refrained from trying to decode, instead clicking the full page TTS. Another five students did not at any point try to decode words independently. These results suggest that by using TTS and talking books in reading instruction without measures to fine tune the scaffolding, it is very doubtful whether any students benefit from the TTS at all.

INTRODUCTION

Digital learning materials and information and communication technology (ICT) in education is a high priority subject at all levels of education. But the results of implementing digital learning materials and ICT in practice are often quite meagre. This is also the case with the use of technology in beginning reading instruction (Slavin et al. 2010,p. 17).

In beginning reading instruction, the advent of digital learning materials has led to neither modification nor redefinition (Puentedura, 2011) of instruction. Most often the digital learning materials offer phonics-based skill-and-drill instruction.

The present study is the first step in a research project in educational design that aims to arrive at a design that allows whole classes to work independently with the same unfamiliar, meaningful text in a way that will make the students acquire decoding skills as well as experience meaningful reading. In the iterative designs, text-to-speech-technology (TTS) will be implemented as part of the designs for learning. In the present study, talking books with TTS will be used as part of a theory-based design for learning in order to see if the students interact with the text and TTS-support the way that is intended in the design for learning. Talking books are multimodal and interactive books that usually allow the user to have written text read aloud, look at still or moving images, and do exercises.

The notion of level of frustration in reading originates from Emmet Albert Betts (1946/1957), but the term is commonly used today. Betts defined frustration level to be when the child is unable to pronounce 10% or more of the running text (Betts, 1957, p. 451). We might expect student frustration from decoding difficulties to be impeded when students interact with a learning material with TTS.

THE RESEARCH QUESTIONS ARE:

- How will students act towards texts which are at their frustration level (i.e. below 90% reading accuracy) when participating in this design for learning with TTS-support? To what extent and how will the students try to decode the texts, and will they use the support as they are instructed to do?
- What can these observations tell us about what to consider in creating a digitally supported learning environment which uses TTS as part of a scaffold to make reading instruction more effective and meaningful for the student?

TTS AND TALKING BOOKS

Most studies have investigated TTS as a tool for remedial reading (Olson, 1992; Olofsson, 1992; Karemaker et al., 2009). Research suggests that stronger readers gain less from using TTS in various contexts, and the conclusion has often been that only struggling readers should be offered TTS (Balajthy, 2005).

In the present study, TTS is considered a relevant aid to all students in their literacy-development. Students can read more text independently and texts of greater difficulty and quality, if they can use the TTS function in ways that support their literacy acquisition. TTS is part of a design for learning in this study, which sets it apart from other studies with talking books or TTS (Parr, 2008; Lefever-Davis & Pearman, 2005).

Much of the research on TTS is carried out with talking books, where students can most often activate TTS on single words, paragraphs, or whole pages. These software products usually have a variety of texts, multimodal and interactive effects, exercises, and so forth. Therefore it is difficult to compare these studies (Karemaker et al., 2009) and the effect of TTS is not isolated.

Classroom-based research with multimedia literacy software is rare (Karemaker et al., 2009). A very important point in studying student behaviour is that the presence of the researcher observing the child reading might alter the behaviour significantly. In a preliminary study to the present one, the researcher delivered the intervention to single students. This led to very promising results: The students' attention was undivided and even struggling readers made attempts at decoding every word in texts at their frustration level. Even though the researcher was not permitted to help the students decode a word, the mere presence of the observer acts as a source of direction maintenance (Wood et al., 1976), keeping the student focused on the task and in line with the instructions.

Lefever-Davis & Pearman (2005) observed first grade students using CD-ROM storybooks with optional TTS for selected words, sentences, or the whole story. They found that students were distracted by the features and animations on the pages and that the students were frustrated when usability was lacking; both observations are confirmed in the present study. More interestingly, the observers found that some students often did not try to decode words themselves but relied on the TTS function. Furthermore, the students often clicked on words that had previously been read aloud, or they had words that they independently had read previously, which they read aloud at a later instance. Some students, on the other hand, used TTS

as a model to strengthen their ability to read aloud or chimed along with the computer narration. Finally some students used the TTS to confirm that they had decoded a word correctly.

The findings of Lefever-Davis & Pearman, C. (2005) might actually tell us more about children's informal interaction with multimodal texts than about the affordance (Norman, 1999) of these materials in reading instruction. The researchers did not try to cue the students on how to use the storybooks, instead intervening as little as possible during the reading sessions (Lefever-Davis et al., 2005 p. 448). If the storybooks were not part of a design for learning, it is not surprising that the students themselves did not bother to try decoding.

Littleton et al. (2006) found that boys 5-6 years of age used the features in a talking book adaptively and appropriately according to their phonological proficiency (Littleton et al., 2006 p. 17).

LEARNING MATERIALS AND DESIGN FOR LEARNING IN THE INTERVENTION

In this study, the intervention is based on connectionist theory of reading and Share's self-teaching hypothesis. These will briefly be presented. The theories will be used to establish which patterns of reading behaviour are most beneficial for students' acquisition of decoding skills.

In the classroom interventions, a learning material with TTS (Abc.dk) is re-didacticized, i.e. it is used in ways not anticipated by the producers of the materials. The learning material consists of various graded texts and the student can activate TTS on single words or the whole page by a single click.

CONNECTIONIST MODEL OF WORD READING

Connectionist models of reading are opposed to dual-mechanism theories in describing how a reader in a deep orthography like English or Danish learns to read words. Dual-mechanism theories assume that when the reader learns the correspondence between spelling and sound, there are two types of knowledge involved: For regular words we use the rules of language

and exceptions have to be memorized (Coltheart et al., 2001). The practical consequence of this view of reading is that students in early grades should practice on regular words and learn the most important irregular words by heart, one word after another.

Connectionist models of reading acquisition assume that we learn to read through exposure to words and text. All cognitive information is stored as a series of connections between units. When we see two letters standing next to each other the connection between these two units becomes stronger. The next time we see one of these letters the positive excitation of the other letter will have become stronger, but other units are excited as well. The connections between units grow stronger or weaker with exposure to print.

Connectionist models explain how students learn to read in deep orthographies even though they have not even remotely learned all the rules of the language. Connectionist models of reading point out that English and Danish orthographies are not rule-governed, they are quasiregular (Seidenberg, 2005, p. 238). When we see a spelling pattern, we have stored a series of possible pronunciations from previous exposures to the spelling pattern; each possible pronunciation has a weight depending on the frequency of previous exposure, and all the possibilities are activated when the reader encounters the spelling pattern. Adams has shown that poor readers differ from more skilled readers in their knowledge about sub-word spelling patterns (Adams, 1990, p. 114).

Also, connectionist models of reading could lead to a redefinition of readability. From a dual-mechanism point of view, an accessible text for a beginning reader is one where there are a lot of regular words and where the student has sight-word recognition for all irregular instances. Instead, connectionist theory points out that when the student reads part of a word, this activation helps him read all other words where the word part is present. Therefore it is the frequency of the word and the consistency and frequency of its constituent parts that determine if a word is easy to read.

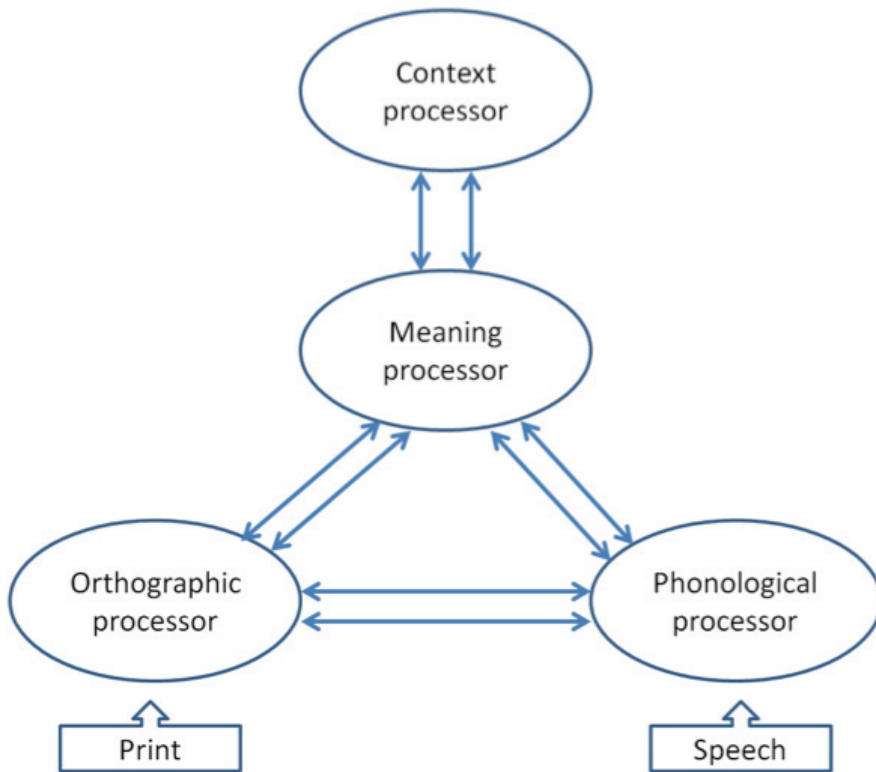


Figure 1: Parallel distributed processing (pdp) model from Adams (1990: 158)

In the connectionist model of reading (Figure 1), four processors work together: The context processor, the meaning processor, the orthographic processor, and the phonological processor. When reading a printed text, the reader will use the orthographic processor to process the visual input of the string of letters. The phonological processor is immediately activated, and if the word string is pronounceable feedback is sent to the orthographic processor. Also the meaning processor is activated when a word is identified in the orthographic processor. It is a very important point that feedback runs both ways and that the meaning processor is connected to the three other processors. The meaning processor can help the orthographic

processor in that the meaning processor, giving and receiving feedback to and from the context processor, helps the search for the most likely word. The context processor is where the meaning of sentences, paragraphs, and texts is brought together in a coherent message, if possible. Also the context processor sends information to the meaning processor about what the next words are likely to be.

The notion of context has to be broadened to encompass non-verbal aspects of the text. The talking book in this study gives the student different paths to identifying a word and a number of possible reading paths. Words are situated in a multimodal context (Kress & van Leeuwen, 2001; Kress, 2003):

- Words are represented both in writing and optionally in sound, whereby the student can identify a word visually, using the orthographic processor, and audibly, using the synthetic voice. The activation of TTS can be considered a backup facility to the phonological processor if the reader encounters a word which he knows aurally but has never seen before in writing. Also the TTS can compensate if the students' decoding skills are not sufficient for a full processing of the orthographic input. The activation of the TTS will allow the student to connect the auditory input with the orthographic representation whereby the student can learn the pronunciation of spelling patterns and whole words.
- Short, animated movies or movie clips accompany the verbal texts. These may lead to distraction from both the orthographic input and the storyline (Pearman & Chang, 2010).
- The logic of the visual characterises the organisation of the interface; it is a screen rather than a page (Kress, 2003, p. 136). At the centre of the screen are the two main blocks: the written text and the animation (Figure 2). The organization of the blocks suggests that the text should be read before viewing the movie (Kress, 2003, p. 69), but this reading path from left to right was virtually impossible for the students to follow, because the movie is

more salient as it starts automatically and often is quite noisy. The students cannot stop the animation or turn off the sound and therefore this block attracts immediate and often prolonged attention.



Figure 2: Screen dump from abc.dk

BEHAVIOUR

Connectionist theory of reading and Share's self-teaching hypothesis are compatible with each other and suggest that TTS should be used by the students in certain ways in reading instruction, while avoiding or limiting other uses. In other words, some patterns of behaviour are more desirable than others, if we aim to develop students' ability to decode words and their literacy in general.

Share (1995, 1999) found that students could acquire lasting orthographic knowledge about single words by individually working with phonological

recoding of new words. According to the self-teaching hypothesis a student will, with every successful recoding of a new word, have the opportunity to create a word-specific orthographic representation of the word. The students will only have to be exposed to the word a few times; Share (2004) showed that a single exposure can be enough. Bowey & Muller (2005) showed that self-teaching also applies to silent reading. Share's experiments were carried out with texts written in Hebrew, which is a shallow orthography. Cunningham et al. (2002) showed that there is a similar effect in deep orthographies.

In line with connectionist theory, Share's self-teaching hypothesis states that a meaningful, textual context is significant when students build orthographic representations. Especially, context could be assumed to be important when the student encounters an infrequent word or irregular word and is only capable of a partial processing. In these cases, context should help the student in identifying the correct word. So context is essential to learning orthographic representations in irregular words (Wang, 2011).

Rosenthal & Ehri (2005) carried out experiments that indicate that it is not essential that the students sound out the words in their attempt to decode them. Rather, it is "the implicit, spontaneous activation of alphabetic knowledge that connects graphemes to phonemes to secure the spellings of specific words in memory." (Ehri, 2005, p. 179). Also, connectionist theory stresses the careful scrutiny of the orthographic input as essential to development of word reading skills and spelling patterns (Adams, 1990, p. 111).

According to connectionist theory, it is of great importance that the student grasps the component parts of the words instantly. The stimulations of the visual recognition units for all the parts of the word have to be active at the same time for the crucial connections between the letters to be learned by the student (Adams, 1990, pp. 112-113).

Reading instruction can be based less on skill-and-drill if students can self-teach reading skills by exposing themselves to texts as long as they keep trying to decode the words they encounter by paying careful attention to the

orthographic input. Instead, instruction can be based more on meaningful encounters with text and unfamiliar words.

Of course, in order for students to learn to read they must work on decoding the written words (i.e. use the orthographic processor to process the print). Cognitively, according to connectionist models of reading, if the student succeeds in decoding a word from the orthographic input, he might or might not depend on activation from the phonological processor (Adams, 1990, pp. 157-162). The main advantage of the learning materials in question is that they allow the students to activate the right word through speech activation, if they do not succeed in activating the right word through the orthographic path.

The TTS does not provide prosody because it is a synthetic voice, so the information from both the phonological and orthographic processors will still need the context processor to determine the meaning of a given word in relation to the co-text. Even if the student identifies a word he knows from the orthographic processing, he might use the context processor to become aware that the word activated does not make sense. Finally, the student might use the animated sequences and movies as context cues which can assist the activation of the right word. Of course pictures and movies are in themselves polysemic modes of representation, so it is not possible for the student to know exactly what the words in the written text are just by looking at the images.

Reitsma (1988) compared three different methods of practicing reading: guided reading, reading-while-listening, and independent reading with TTS. He found that guided reading and independent reading with TTS were significantly more efficient in acquiring orthographic knowledge about words. In the learning material examined in this study, students have a reading-while-listening option. It is hard to say from the data whether students read while listening or not, which is a common flaw with this method (Reitsma, 1988); but the important thing is that this is not the optimal path to take for the student interacting with this material.

So the aim is to get the students to try to read every word and check with the speech-feedback only in two instances:

- if the identified word seems odd in relation to the context
- if the student

CHALLENGES AND POSSIBLE SOLUTIONS

Share's results were obtained through controlled experiments. An important part of the self-teaching hypothesis is that the student should be left to his own devices and should not have any support in his reading endeavours (Cunningham et al., 2002, p. 3). So the student can identify wrong words, he can skip words that he is not able to read, or he can guess. According to Adams, these are not good strategies for the unskilled reader (Adams, 1990, p. 132). If the student is not to give up on scrutinizing every word carefully, we must assume that text should fit students' zone of proximal development very tightly, or else the student might be frustrated, and even worse, lose sight of the storyline. This is where materials with TTS can potentially facilitate frustration control making help available to the student, and this in turn can facilitate direction maintenance in that the student is kept on track in focusing on making sense of the text (Wood et al., 1976).

On the other hand, in the learning material that was used in this study, TTS is like a scaffold that cannot be faded or adapted to suit the individual learner's problems and needs. For example, there is nothing to stop students from having the whole text read aloud without trying to decode.

METHOD

A first grade class ($n = 17$)ⁱ from a Danish public school, students being seven to eight years of age, and most of them typically developing readers, participated in the intervention. Each student was assigned a laptop computer and was told that his actions were recorded by the computer.

Using screen recording software (CamStudio), it was possible to record a visual representation of the students' interaction with the software. Also the students' verbal output was recorded as audio from the built-in microphones of the laptops. Even though students were informed about the re-

cordings, the way some students acted during the intervention suggests that they forgot that their actions and lack thereof were being observed. Screen recording, therefore, potentially produces very reliable data.

Only one recording was carried out simultaneously with the whole class. Therefore the scope of the intervention is limited to showing what the students did at one specific point in the intervention, showing that development in students' behaviour is highly relevant but requires an intervention of longer duration.

PROCEDURE

The students' usual teacher delivered all the interventions (2 x 1 hour). The researcher had written a thorough lesson plan for the teacher including detailed instructions on how to introduce the activities and what to do when guiding the students during individual reading.

The texts were selected so that they were supposed to be above instructional level in difficulty for most students. The point of this was to make sure that most students would need support and to see if and how the students would use the TTS support.

For the first hour of intervention, the students were divided into two groups that received the intervention at different occasions to make sure that the teacher could individualise her instruction on how the software worked and how and when the students were supposed to use the features in the software. The next lesson the whole class was together.

The principles of the two lessons were identical: The students were asked to read the texts individually. The students were on both occasions instructed to try to read every word themselves and only to click for help if they did not succeed in reading the word on their own. Before the students read the texts individually, the teacher talked to them about the theme and a few difficult words of the texts; in the last intervention, which was the one that was recorded, the subject was slowness and the class discussed the word and concept *langsomt* (slowly) and which other words the word part “-somt” is part of. Furthermore, the word *slentre* (to stroll) and the idiom *at snegle*

sig fremad (to move forward extremely slowly) were spelled out collectively and talked about. The point of discussing the theme of the story was to make the students pay attention to the narrative, i.e. using information from the context processor to determine whether the story was coherent and if a word identified through the orthographic processor might be incorrect. Going through the difficult words was done to see if this would help the students reading the words, but no significant effect of this part of the preparatory work was found.

The two stories had the same main characters, structure, and events. The main difference between the texts is that in the first text the main character lives in the land of backwards, whereas in the second story he lives in the land of slowness. In other words there should be a good chance that the students had learned some of the repeated words as sight words before the last intervention (Ehri, 2008; Share, 2004; Reitsma, 1988; Rashotte & Torgesen, 1985). After the individual reading, the students were instructed to read the story aloud taking turns in pairs. At the end of the lesson the teacher talked to the students about the story, posing questions demanding varying degrees of feedback from the students.

STRATEGY FOR ANALYSIS OF DATA

In this study, the objective is not to determine the effect of the intervention directly. Instead, the theoretic base is used to determine which behavioural patterns on the part of the students can be assumed to lead the students to building orthographic representations. In other words, the assumption behind the analysis of the recorded behaviour is that the students must act in certain ways towards the text and the software in order to maximize the effect of their activities.

The recordings are used to produce quantitative data. Because the recordings show a visual representation of the students' interaction with the software as well as an auditory representation of the students' reading process, it is possible to analyse both the number of correctly read words, words read correctly after attempts, types of reading errors, types of activation of TTS, the relation between reading attempts and activation of TTS, parts of the text not read or listened to, and finally the students' verbal response to the

synthetic speech. It is a matter of interpretation whether or not a student makes an attempt at decoding a word. Most of the time, however, there is no doubt; many students verbalise their attempts and many students use the cursor for tracking, so it is possible to see where they are focusing their attention (Lefever-Davis et al., 2005). Also, many students move on so quickly to the next word that it cannot be considered an attempt. The accuracy rate was calculated as the percentage of words the students tried to read and succeeded in reading either immediately or after trying other pronunciations. This means that words that were read aloud by the software are not included in this measure.

Parr (2008) observed that some students read along with the digital speech. This was also the case with three students in this study. Some students clearly decoded the text independently and were ahead of the digital speech; in these instances the words will be counted as independently read. Often the students activated the reading aloud of a whole page, but really only needed help with a single word. Other students tried to repeat what they could hear; in these cases the words are counted as read aloud by the computer, since the students do not access the words' meaning through the orthographic path.

RESULTS

Table 1. Results of the data analysis.

Student #	No. of words read independently	No. of words read independently, but not instantly	Miscue/failed attempts	Accuracy rate	No. of miscues/failed attempts leading to activation of TTS	No. whole pages read by TTS/no. words	No. of single words read by TTS	Guessing	No. of words neither decoded nor read aloud by TTS	Reading along with TTS	Repeating TTS	No. of the 3 words that were instructed directly read correctly on the words' first occurrence
1	2 *	0	1	66,6 %	0	7/80	0	0	25	0	0	0
2	3 *	0	0	100 %	0	8/104	0	0	0	0	0	0
3	0	0	0	0 %	0	6/41	0	0	66	0	0	0
4	0	0	0	0 %	0	9/107	0	0	0	0	9	0
5	77	8	7	92 %	1	1/23	0	0	0	4	0	2
6	19	1	52	27 %	0	1/16	4	42	16	0	1	0
7	57	2	19	75 %	3	0/0	3	6	3	0	3	0
8	0	0	0	0 %	0	9/107	0	0	0	0	5	0
9	3	0	2	60 %	2	6/68	15	0	21	0	14	0
10	9	0	17	35 %	4	2/17	14	16	36	3	6	0
11	32	0	6	91 %	1	2/11	53	4	2	11	57	1
12	25	0	5	83 %	4	8/81	0	0	0	0	0	1
13 ²	110	2	15	88 %	0	0/0	0	0	35	0	0	0
14 ²	64	0	1	98 %	0	0/0	0	0	86	0	0	1
15	0	0	0	0 %	0	0/0	0	0	107	0	0	0
16	79	3	3	96 %	0	1/21	1	0	1	0	0	2
17 ²	7	1	2	78 %	0	6/9	0	0	37	0	0	0

* = The student only read the first words in the text

² = By mistake the students worked with another version of the text, which was of higher grade than the one intended. The other text has more words, longer sentences and more difficult words but the title, characters and plot is the same as in the intended text.

Table 1 shows the results of the data analysis. There is a correlation between students reading many words independently and having a high rate of accuracy. Also students reading many words independently tend to ignore the possibility of having whole pages or single words read aloud. Students who read very few words independently most often have the whole page read aloud but do not use the single-word function.

The students can be divided into four categories from the way they behaved towards the text and the software.

STUDENTS WHO CAN BUT DO NOT

Five students showed that they were quite capable of decoding a lot of the words in the text, but they quickly refrained from trying. Four students (#1, #2, #12, and #17) activated full-page reading the first time they encountered a word they could not decode immediately. The students overused the op-

tion to have the whole page read aloud, because they activated the function without trying to read a single word in the following pages. At best they were silently reading-while-listening. But students #1 and #12 skipped parts of the text without listening to the reading aloud, which indicated that they were not paying attention to the story.

STUDENTS WHO PROBABLY CANNOT AND DO NOT

Five students probably could not and did not try. Four students (#3, #4, #9, and #15) did not try to read one single word and consistently and immediately activated the full-page reading function. One of them (#15) did not even activate the reading aloud function but quickly browsed through the text. Students #3 and #9 also skipped some of the pages not having read them aloud. Students #3 and #4 are struggling readers, according to their teacher. Student #8 is average for the class. Student #9 gave up very quickly and read only the name of the main character and one two-letter word and then activated whole-page reading. These four students could not be supposed to benefit significantly from the activity.

STUDENTS WHO CAN AND PROBABLY SELF-TEACH – BUT RARELY OR NOT AT ALL USE SUPPORT

Four students (#5, #7, #13, and #16) could read the text at a level that is close to or at instructional level. These students tried to decode every word. Student #13 tried to read every word – and mostly succeeded. He skipped some passages, probably because he was reading a harder version of the text; at one point he exclaimed “Oh, my God. This is hard!” These students could be supposed to be self-teaching. They relied almost exclusively on the orthographic input. In fact, they underused the support. Student #7 tried to read most of the words, and three times he activated single-word TTS to get the correct word or confirm the result of his endeavour. There were also incidents, however, where he did not identify a known word and where he did not use the help to get the correct word. Student #5 did not use the single-word TTS at any point even though she had seven miscues/failed attempts. Student #16 stuck to the orthographic path and did not activate TTS when he did not succeed in identifying a known word.

Student #14 was reading the difficult version of the text but read whole sentences fluently. However, he did not seem motivated; he skipped words, sentences, and whole pages. At one point the girl sitting next to him said that she found the activity difficult to which he replied that he did not and went on to read a sentence aloud fluently. At no point did he use the support.

STUDENTS WHO ARE IMPATIENT AND DISTRACTED

Two students (#6 and #11) could be described as impatient and distracted. Student #6 used contextual cues (animations and verbal context) and partial decoding for guessing. On the first three to five pages he tried to read every word but immediately guessed, and on three occasions activated the single-word TTS. Some students let information from the animated sequences overrule the orthographic input. For example three students (#6, #10, and #11) had the same miscue: in the material the written words say “Otto flytter til et andet land” (Otto moves to another country), but a lot of the students read “flytter” (moves) as “flyver” (flies), probably because the animated sequence shows an aeroplane flying from one country to another.

Student #11 was an interesting case from a connectionist and self-teaching point of view. This student was very impatient; either he immediately decoded a word or he immediately clicked for single-word TTS. The question is whether the very short exposure to words he does not succeed in decoding leads to him building orthographic representations. The word “langsom/langsomt” (slow/slowly) was repeated a total of five times in the text. The first time the student succeeded in reading the word, but he activated TTS on the next four occurrences. This and the fact that he read almost all the short, frequent words immediately and independently, suggests that he might only allow himself time to see whether it is a long word or not before activating TTS.

DISCUSSION

This study is part of a larger project in which I aim to find ways of capitalising from digital support including TTS in reading instruction. Following the methods of Design Based Research, the first step is problem identification (McKenney et al., 2012).

The present study exemplifies the challenges in using technology in education. Donald Norman's use of the term *affordance* (Norman 1999) seems highly appropriate; the affordance of TTS is indeed highly actor-dependent. In order for scaffolding to be appropriate, the students need *metascaffolding*, i.e. scaffolds for the scaffolds (Pea, 2004, p. 433). They must learn how to use the support as a tool for learning.

As a tool for scaffolding students' individual reading with the purpose of self-teaching, TTS has the potential to accomplish *frustration control* (Wood et al., 1976). It is a well-established assumption that students benefit the most from independent reading, when they read with at minimum 95% accuracy in decoding and word recognition. Below 95% accuracy, reading comprehension and reader interaction with the text is limited (Adams, 1994; Clay, 1993). At 89% or less, accuracy is considered frustration level. But this axiom is being challenged: Focus is being directed towards scaffolding and supporting students instead of being concerned solely with text difficulty and an exact match between reader and text (Fischer et al., 2012). TTS should be able to overcome "the decoding bottleneck experienced by beginning readers" (McKenna et al., 2003, p. 193).

In this study, only the students that did not use the TTS support can be said to have been frustrated by the activity. Most of the other students did not allow themselves to be frustrated.

The students who based their reading solely and thoroughly on the orthographic input tried to read every word and often re-read words, sometimes arriving at the right word, sometimes not. But these students tended to ignore the possibility of having words read aloud by the TTS completely. Students who persistently try to decode every word should be more aware of contextual cues or get used to react to contextual cues. This is the only way for them to become aware of their miscues and so create a coherent message from the text. It is possible that these students perceive reading as decoding, not making an effort to understand what they read. Reading experiences with meaningful, unfamiliar texts could contribute to strengthening metacognition with these students.

From another but, I think, compatible view, researchers conceptualising literacy as a social practice are making a case for the purposefulness of students' reading practices (Barton et al., 2000). I think the sociocultural perspectives on literacy give valuable directions as to how literacy practice should generally be carried out in education, but the sociocultural theories do not seem to provide an approach to teaching children to read that is compatible with the findings of cognitive research. In my research, I turn to cognitive research for new ways to understand how we support literacy acquisition in education, and through learning materials, without making reading instruction a strictly technical and decontextualized matter.

Some students never reached a state of frustration or allowed themselves to be challenged by the text. Instead they quickly let the TTS read whole pages aloud without attempting to read themselves in spite of the teacher's instructions. Some students repeated words that were read aloud for them, while some didn't even listen to the TTS. That some students do not try and do not challenge themselves, suggests that their performance is inhibited by their self-image as readers and less by the level of difficulty of the text (Dymock, 1993; Beers, 2003). TTS does not, when used unsupported by these students, help in countering the Matthews effects in reading (Stanovich, 1986). These students use TTS as a tool for living not as a tool for learning, because they are not limiting their use of the support and not acting in ways that could enable them to decode the targeted words independently in the future. Rather than "scaffolding", Roy Pea suggests the term "distributed intelligence" for behaviour and cognitive support that is not faded (Pea, 2004, p. 431).

Other students should be directed towards the orthographic information or get used to trying to decode a little longer.

The teachers in the project normally use the talking books as learning material the students can use at home. The work at school merely serves as an introduction to the program that should encourage the students to read in their spare time. But for many students this would be rather pointless if they are not scaffolded in ways that increase the benefit of their interaction with the materials vis-à-vis reading development.

Further research in this project will try to establish which scaffolding measures could supplement TTS and provide reduction in degrees of freedom, direction maintenance, and mark critical features (Wood et al., 1976) in order to enhance the effect of independent reading and self-teaching.

The students in this study are used to reading a basal reader designed according to the principles of phonics. In other words, students are used to having the teacher go through irregular words with the class and to reading the text along with the whole class repeatedly before trying to read it individually. This scaffolding and emphasis on not letting the student work with unfamiliar text could cause the paralysis observed in many of the students in this study when dealing with unfamiliar text. From a connectionist point of view, students read too little text in their usual reading instruction; they are not exposed to a lot of words and word parts and therefore have too few opportunities for making and strengthening the crucial connections.

If all students are to capitalise from the self-teaching mechanism, and if connectionist models of reading-acquisition are to be the foundation of reading instruction in the early grades, we need to develop learning designs and learning materials that can make students in the early grades more self-efficient in learning processes designed to develop literacy.

REFERENCES

- Adams, M. J. (1990). *Beginning to read: Thinking and Learning about Print*. Cambridge, MA: MIT Press.
- Adams, M.J. (1994). Modeling the connections between word recognition and reading. In R.B. Ruddell & N. J. Unrau (Eds.), *Theoretical models and processes of reading* – (5th Ed., pp. 1210-1243). Newark, DE: International Reading Association.
- Balajthy, E. (2005). Text-to-speech software for helping struggling readers. *Reading Online*, 8(4), 1-9.
- Beers, K. (2003). *When kids can't read: What teachers can do*. Portsmouth, NH: Heinemann.
- Barton, D. & Hamilton, M. (2000). Literacy practices. In D. Barton, M. Hamilton, & R. Ivanič(Eds.), *Situated literacies: Reading and writing in context* (pp. 7-15). London: Routledge.
- Betts, E. A. (1957/1946). *Foundations of reading instruction with emphasis on differentiated guidance*. New York, NY: American Book Company.

Bowey, J.A. & Muller, D. (2005). Phonological recoding and rapid orthographic learning in third-graders' silent reading: a critical test of the self-teaching hypothesis. *Journal of Experimental Child Psychology* 2005 Nov; 92(3):203-19.

Clay, M. M. (1993). An Observation Survey of Early Literacy Achievement. Portsmouth, NH: Heinemann.

Coltheart, M., Rastle, K., Perry, C., Langdon, R., & Ziegler, J. (2001). DRC: A dual route cascaded model of visual word recognition and reading aloud. *Psychological Review*, 108, 204–256.

Cunningham, A.E. et al. (2002). Orthographic learning during reading: examining the role of self-teaching. *Journal of Experimental Child Psychology* 82 (2002) 185–199.

Dymock, S. (1993). Reading but not understanding. *Journal of Reading*, 37(2), 86-91.

Edyburn, D. L. (2007). Technology-enhanced reading performance: Defining a research agenda. *Reading Research Quarterly* 42/1.

Ehri, L. C. (2008). Development of Sight Word Reading: Phases and Findings. IN: Snowling, M. J. & Hulme, C. (RED): *The Science of Reading: A Handbook*.

Fischer, D., Frey, N. & Lapp, D. (2012). *Text Complexity: Raising Rigor in Reading*. International Reading Association.

Frost, R. (2005). Orthographic Systems and Skilled Word Recognition Processes in Reading. In M. J. Snowling & C. Hulme (Eds.), *The Science of Reading: A Handbook* (272-295). Oxford: Blackwell

Karemaker, A.M., Pitchford, N.J., & O'Malley, C. (2009). Enhanced recognition of written words and enjoyment of reading in struggling beginner readers through whole-word multimedia software. *Computers and Education*. DOI: 10.1016/j.compedu.2009.07.018

Karemaker, A.M., Pitchford, N.J., & O'Malley, C. (2008). Does whole-word multimedia software support literacy acquisition? *Reading and Writing*. DOI: 10.1007/s11145-008-9148-4

Kress, G. and van Leeuwen, T. (2001). *Multimodal Discourse: The Modes and Media of Contemporary Communication Discourse*. London: Arnold.

Kress, G. (2003). *Literacy in the New Media Age*. Routledge.

Lefever-Davis, S., & Pearman, C. (2005). Early readers and electronic texts: CDROM storybook features that influence reading behaviours. *The Reading Teacher*. 58(5), 4-10.

Littleton, K., Wood, C. and Chera, P. (2006). Interactions with talking books: Phonological awareness affects boys' use of talking books. *Journal of Computer Assisted Learning*, 22(5), pp. 382–390.

McKenna, M. C., Reinking, D., & Bradley, B. A. (2003). The effects of electronic trade books on the decoding growth of beginning readers. In R. M. Joshi, C. K. Leong, & B. L. J. Kaczmarek (Eds.), *Literacy acquisition: The role of phonology, morphology, and orthography* (pp. 193–202). Amsterdam: IOS Press.

McKenney, S. & Reeves, T. C. (2012). *Conducting Educational Design Research*. Routledge.

National Institute of Child Health and Human Development (2000). *Report of the National Reading Panel. Teaching children to read: an evidence-based assessment of the scientific research literature on reading and its implications for reading instruction: Reports of the subgroups* (NIH Publication No. 00-4754). Washington, DC: U.S. Government Printing Office.

Norman, D. A. (1999). Affordance, Conventions and Design. *Interactions* 6(3):38-43, May 1999, ACM Press.

Olofsson, Å. (1992). Synthetic Speech and Computer Aided Reading for Reading Disabled Children. *Reading and Writing: An Interdisciplinary Journal* v4 p 165-78. June 1992.

Olson, R. K., Wise, B. W. (1992). Reading on the Computer with Orthographic and Speech Feedback: An Overview of the Colorado Remediation Project. *Reading and Writing: An Interdisciplinary Journal*, v4 n2 p107-44 Jun 1992. (EJ483146)

Parr, M. (2008). *More than Words: Text-to-Speech Technology as a Matter of Self-Efficacy, Self-Advocacy, and Choice*. Retrieved from digitool.library.mcgill.ca/thesisfile18738.pdf

Pea, R. (2004). The Social and Technological Dimensions of Scaffolding and Related Theoretical Concepts for Learning, Education, and Human Activity, *The Journal of the Learning Sciences*, 13 (3), 423-451.

Pressley, M., Rankin, J. & Yokoi, L. (1996). A Survey of Instructional Practices of Primary Teachers Nominated as Effective in Promoting Literacy. IN: *The Elementary School Journal*, vol 96, nr. 4.

Puentedura, R. R. (2006). *Transformation, Technology, and Education*. Retrieved from <http://hippasus.com/resources/tte/part1.html>

Rashotte, C. A., & Torgesen, J. K. (1985). Repeated reading and reading fluency in learning disabled children. *Reading Research Quarterly*, 20, 180 -18.

Reitsma, P. (1988). Reading practice for beginners: Effects of guided reading, reading-while-listening, and independent reading with computer-based speech feedback. *Reading Research Quarterly*, 23, 219-235.

Seidenberg, M. (2005). Connectionist Models of Word Reading. *American Psychological Society* Vol 14, nr. 5.

Shanahan, T. (2006). *The National Reading Panel Report. Practical Advice for Teachers*. Learning point Associates.

Share, D. (1995). Phonological recoding and self-teaching: sine qua non of reading acquisition. *Cognition*, 55, 151–218.

Share, D. (1999). Phonological recoding and orthographic learning: A direct test of the self-teaching hypothesis. *Journal of Experimental Child Psychology*, 72, 95–129.

Share, D. (2004). Orthographic learning at a glance: On the time course and developmental onset of self-teaching. *Journal of Experimental Child Psychology*, 87, 267–298.

Share, D. & Gur, T. (1999). How reading begins: A study of preschoolers' print identification strategies. *Cognition and Instruction*, 17, 177–213.

Slavin, R. E., Lake, C., Chambers, B., Cheung, A. & Davis, S. (2009). Effective Beginning Reading Programs: A Best-Evidence Synthesis. *Review of Educational Research*. Vol. 79, Iss. 4; pp. 1391-1466.

Stanovich, K. E. (1986). Matthew Effects in Reading: Some Consequences of Individual Differences in the Acquisition of Literacy. *Reading Research Quarterly* 21(4): 360–407.

Wang, H.C., Castles, A., Nickles, L. & Nation, K. (2011). Context effects on orthographic learning of regular and irregular words. *Journal of Experimental Child Psychology*, Vol. 109, Issue 1, May 2011, Pages 39–57. Retrieved from <http://www.sciencedirect.com.ez-vas.statsbiblioteket.dk:2048/science/article/pii/S0022096510002250>

Wood, D, Bruner, J. S. & Ross, G. (1976). The Role of Tutoring in Problem Solving. *Journal of Child Psychology and Psychiatry*, Vol. 17, 1976, pp. 89-100. Pergamon Press.

Editorial: RIKKE ØRNGREEN

SUSANNE KJÄLLANDER & FARZANEH MOINIAN:

*Digital tablets and applications in preschool.
Preschoolers' creative transformation of didactic design*

JACOB DAVIDSEN & ELLEN CHRISTIANSEN:

*Mind the hand: A study on children's embodied and
multimodal collaborative learning around touchscreens*

BIRGITTE HOLM SØRENSEN & KARIN TWEDDELL LEVINSSEN:

Digital Production and Students as Learning Designers

STIG TOKE GISSEL:

Talking Books in Reading Instruction and Student Behavior

