IARTEM *e-Journal*

Volume 1 No 1

Volume 2 Number 1

Reconsidering considerate textbooks

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Abstract

How could results from research on learning within science education be transferred to the development of textbooks? With this question as starting point in the article five maxims for good learning texts are suggested. The maxim of *optimizing* emphasizes the need to meet the reader at his/her level of understanding. The maxim of *structure* underlines that texts should be well structured. Although this can be considered especially important as learners in school settings mostly approach new areas as novices, some paradoxes deepen the maxim. The activity of readers could be maintained by signals provided by the authors (the maxim of *metadiscourse*). Extensive research within science education shows problems in learning core concepts, like gravitation, photosynthesis and the movement of light. These problems emphasize the need to confront learners with possible misinterpretations (the maxim of *conflict*). Finally different ways of enhancing the motivation of the reader are suggested in the maxim of *pleasure*.

Introduction

The extensive use of textbooks in Finnish schools (Atjonen et al 2008) gives reason to speculate that textbooks play a considerable role in the consistently good results by Finnish pupils in international school assessments like PISA (OECD 2006). This speculation motivates an analysis of the relation between research on learning and textbook improvement.

The heading of the article alludes to an article by Kantor, Anderson and Armbruster (1983), who from a rhetorical perspective formulated four maxims for *considerate texts*. The maxim of (1) *structure,* concerns the ordering of the ideas in the text. Connected with this is the maxim of (2) *coherence,* focusing on how well the sentences and ideas are woven together. The third maxim, (3) *unity*, deals with the internal consistency of ideas indicating that the unity of a text can be destroyed if there is failure to support a main idea. Finally, (4) *audience appropriateness,* refers to the difficulty of the text and to a need for an adequate match between what the student knows before reading and what the author writes.

In this article the aim is to suggest further maxims, now departing from research on learning, mainly from the field of science education. Though constructivism may have "risen and fallen", to use the metaphor of Solomon (1994), it has proven productive in explaining successes and problems in learning science, and will therefore be used as an explanatory framework. Although not stated explicitly, the view influencing the national curricula in Finland during the last decades has been labeled as constructivism (cf. Korkeakoski 2008). The following five maxims for good learning texts are suggested: *structure*, *optimizing*, *pleasure*, *metadiscourse* and *conflict* (see also Wikman 2004). As textbook researchers sometimes have been criticized for just showing bad examples of various problems in texts, the maxims will be accompanied by, in the interpretation of the writer, good examples.

Structure – 'The picture of the jigsaw'

There seems to be agreement about a notion that a reader does not develop knowledge as separate details but rather as some kind of organized networks (van Dijk & Kintsch 1983). Texts are usually, for most of us, too long to be remembered in detail. Understanding a text therefore involves a compression and structuring of the offered information. A following presumption is, for that reason, that structured texts facilitate the reader's structuring of information. In fact, according to McKeown et al (1992), there is much research indicating that coherent versions of texts enhance comprehension.

The sequencing of the ideas in a text should make sense. One way of doing this is to make the structure explicit. Coherence cannot however be separated

from content. The significance of important information should be made apparent. Merely adding connectors between textual elements is not enough. The central information in the text should be identified by the reader (Beck et al 1989).

Also the knowledge of the reader influences the effect of the structuring. A reader is forced to restructure a text that is not coherent. There is research showing that readers who know little about a domain benefit from well-structured texts. Restructuring of texts does not however always have the desired effects, as knowledgeable readers do not always get better results when reading restructured more coherent texts (McNamara et al 1996; Kintsch 1994). Texts with gaps in the coherence seem to force the reader to process the text on a deeper level and thus promote learning. This could give us reason to ask if good texts always are better. However, the picture is complicated as, according to Vidal-Abarca (2004), the learning of knowledgeable readers can be enhanced by developing more efficient inferences within the texts. If additional information connects different ideas in the text, deep learning of pupils with different pre knowledge can be enhanced according to this research.

To sum up one can agree with Vidal-Abarca, Gilabert and Abad (2002) who emphasise that text structures as such do not affect learning if the reader is not conscious of the structures and unable to identify them. Reading signifies identifying new items in a text and combining them with what is already known. As the message of a text is created by the reader in cooperation with the text, structures, and the signaling of structures, can guide a reader when reading new information.

Although there are individual differences in handling differences in coherence, we can suppose that structuring of texts generally enhances learning in a school setting, because pupils usually read texts as beginners in different subject areas. An example of good structuring will be found down under the maxim of pleasure.

Optimizing

Classical works within educational science (Comenius, Herbart, Vygotsky, Ausubel …) emphasize the importance of taking into consideration the pre knowledge of a learner. Kantor, Anderson and Armbruster (1983) use the concept *audience appropriateness*. I have chosen the term *optimizing* underlining that texts should enhance the learning of individual students with different abilities, and also ensures the growth of the learner to proximal potentials, i.e. to optimize the learning.

The aim of textbook development was for a long period to develop easier texts. The use of readability formula did not however always have the expected results, because the language in the textbooks ultimately turned to simple main clauses not enhancing the understanding (Karvonen 1995; Macdonald-Ross 1978). According to Allard and Sundblad (1986) short texts with high information density automatically get abstract. What usually is said with many words and sentences is compressed and therefore the possibility to use a personal communicative language vanishes. We are encountered with a paradox: How can texts be written easier without getting harder at the same time? If texts are written with too short sentences and without connective ties, the mechanisms usually making the text understandable are broken down. If the sentences are read one by one, the reader may lose the overview of the continuity in the argumentation, i.e. gaps in the inference between the message of the text and the pre knowledge of the reader are established.

Some researchers claim that the texts should be written on different levels and perhaps even be put in different books (Mikk 1999). The variation in problem solving documented by Vygotsky (1962) supports this conclusion. If the aim is to give the students both a possibility to succeed and to be challenged, i.e. to optimize the learning experience, texts going deeply into issues presented can be an advantage.

Tyson-Bernstein (1988) claims, that textbooks in the USA grew superficial because of the demands of covering everything in the national tests. Metaphors like *multiplication table*, *catalogue* and *horoscope* have been used to give a description of the incoherent presentations in textbooks. The texts developed to a "*thin stream of staccato prose among far too many illustrations*".

The textbook authors are interpreters of the significant information in a certain culture. The above description gives reason to argue for a restriction in the amount of themes presented in textbooks. This puts the focus on the selection of content. If we cover few themes and present them deeply, the text can be easier to understand, and at the same time give possibilities to make connections and inferences. If a textbook covers too many themes there is a risk that the result is learning by rote rather than qualitative understanding (see e.g. Vosniadou et al 2001). However, it is easier to state a need for a quantitative restriction of themes in textbooks than to define the concepts few and many.

The authors have to decide what is important, and in this it is easy to agree with Klafki (1963) who stated that the themes selected should represent some general principle. Here the reader of this text could exercise this maxim by deciding which themes focus should be set on in textbooks of the European

history of the 20th century: The world wars, the collapse of the Iron curtain, the economic depression in the thirties?

The prime minister of Sweden, Göran Persson, in 1997 took an initiative to present the Holocaust in a more detailed way as the knowledge of it was perceived to be declining among the people of Sweden. The result, a textbook focusing on just one theme from the Second World War period, is a good example of the principle of optimizing (Bruchfeld & Levine 1998).

Pleasure

Although we can assume that people from the very beginning of their lives are actively trying to make sense of the world, learning in institutional settings has to adapt to the fact that learners not always are interested in what they are supposed to learn. According to Illeris (2001) all learning encompasses psychodynamic aspects. As the curiosity has to be awakened, motivational efforts become essential for the enhancing of learning. Textbooks as the symbolic representations of knowledge should therefore enhance the activity and curiosity of the reader. One suggestion for this is to use narratives.

People seem to need to establish narrative patterns when reading. Stories with beginnings and ends, with a similar structure to each day in our own life or even our whole life, can be pleasurable and thus enhance learning (Michaelsen 1999b). Chambliss and Calfee (1998) point out that stories are interesting because it is easier to feel empathy towards persons than towards facts. It is also easier to build up conflicts and surprising events in stories than in other types of texts. The familiarity of the narratives has also been pointed out as a benefit for comprehension (Vidal-Abarca, Martínez & Bilabert 2000).

Hidi and Baird (1988) showed that interest evoking strategies enhanced the learning from textbooks. However the effect on students' cognitive performance had qualitative differences as the strategies were most effective in increasing recall of concrete (or personally involving) information and did not improve the learning of more abstract, general or scientific information. The challenge remains to develop scientific information engaging.

As the rewriting of texts (making them more coherent) did not have the expected result Beck, McKeown and Worthy (1995), starting from the notion of written text as interpersonal communication, manipulated texts by giving them characteristics from the spoken language. This meant for instance, using verbs in concrete situations instead of passive clauses. The results indicate that texts with more voice, as this adaption was called, and with strong coherence have the best effects.

Results from studies of Reichenberg (2000) support the above research. In order to be successful, transformations, however have to connect to the

essential content of a text. For instance Alexander and Kulikowich (1994) found that supplementary information in textbooks in physics did not give attention to central issues but rather diverted the reader's attention from the essential information in the text.

So far the suggestion for a good learning text within this maxim has been to use the possibilities narratives and the approaching of the text to spoken language. A further possibility would be to give space to discovering activities of the reader by using authentic features in texts. Textbooks are usually not authentic texts. As a result they risk distance from reality. A very good example of the principle of authenticity is exposed in the Dutch textbook *Pharos* (Hagebraats m.fl. 2000). In the presentation various sources force the student actively to take a stand in the reading process. This is because both authentic medieval illustrations and texts, activate the reader from different perspectives to develop personal interpretations.

In another example, now from a German history book (Grolle, Thiele, Rumpf & Lucas 1987), the authors link the adapted texts to an authentic excerpt from a diary of Cardinal Richelieu (the whole chapter is also a good example of the maxim of structure):

> Kardinal Richelieu war 20 Jahre der leitende Minister des französischen Königreichs. Er starb 1642, im selben Jahr wie Galilei, vor seinem Tode äußerte der Kardinal:
>
> „Nur wenn ein Astronom sich bei seinen Berechnungen um keine Minute versieht, können seine Schlüsse frei von Fehlern bleiben; ebenso genau muss auch ein Minister die Interessen des Staates berechnen, wenn er gut regieren will. „ (Richelieu, Politisches Testament, um 1640)
>
> Schon früh hatte Richelieu gelernt, die Interessen des Staates über alle anderen Rücksichten zu stellen. (...)

Even though the excerpt is followed by the authors' interpretation, a possibility for the reader to draw his or her own conclusions is maintained. As the quote stands as a reinforcement of the author's view (not questioning the excerpt), the possibility to present problems to the reader and thus to actively engage him/her is, however, not used to a full extent.

To sum up, both narratives and authentic presentations are suggested to enhance learning because of the possibilities to motivate the reader and to adapt the texts to the earlier reading experiences of the reader. A prerequisite for this is that the reader has possibilities to identify him- or herself in the text starting from the pre knowledge. To use inborn fantasy and to be creative has always been an evolutional advantage for people. However, presentations of scientific content have to be de-contextualized to a certain extent in concept formation. Even if textbooks cannot repeat the whole history of science, there

is a risk that the reformulation of information becomes distanced from empiric reality if the primary sources of the concepts are not kept in mind.

Metadiscourse

All of us supposedly have during reading suffered from, what Miholic (1994) calls, a “metacognitive crash” meaning that our eyes have continued following the lines of the text without us understanding anything. One suggestion for dealing with problems of this kind is adding metadiscourse to the text. This is the author’s discussion about the primary content where the reader is rather directed than informed about what is meant in the primary discourse (Crismore 1984). Metadiscourse means giving the reader possibilities to reflect on his/her own learning. The presented information is brought within reach of the reader by a continuing dialogue between the author and a supposed reader. Especially for pupils who read a subject matter for the first time connecting the new information to earlier knowledge is essential. The textbook gives the reader a possibility to confront the everyday knowledge with the scientific.

Giving the reader a possibility to guide the reader through the text, metadiscourse can inform the reader about assumptions made by the authors. As a reader is in a weak position compared to the writer of a text, and a book never gives a total description of a subject area, there should be, “signposts along this route to warn the reader of the author’s own ideology and to indicate that others are possible” (Lester & Slater 1998, 5).

The following example of a science text from the textbook *Matter and Molecules* (Roseman, Kesidou, Stern & Caldwell 2001, 4) gives examples of the potential benefits and pitfalls of metadiscourse:

> How does evaporation happen? Let’s try explaining it in terms of molecules. You know that the molecules in liquid water are constantly moving. In a liquid, though, the attractive forces between molecules keep them close together. What you might not know is that the molecules in a liquid move at different speeds. Some molecules are moving very fast, while other molecules are moving more slowly.
>
> What do you think would happen if a fast-moving molecule reached the surface of a drop of water? Yes, it would escape! It would break away from the strong attraction of the other water molecules and become a molecule of water vapor in the air. If all the water molecules escape in this way, we say that something has “dried out.” The liquid water has turned into water vapor in the air, and the water vapor makes the air more humid.

An initial question directs the activity of the reader towards the problem dealt with in the text. In the sentence “*You know that the molecules in liquid water are constantly moving*” there is a supposed bridge to what the reader is

thought to know from earlier studies. In the continued text questions keep the activity of the reader alert. From an adult perspective this way of writing seems to be a plausible way of introducing young readers to new information. But what if the reader does not know about "*molecules in liquid water*"? Is the question then turning to a "stupidity marker" reinforcing the problems a reader might have with the subject? Roth (2004) questions the possibilities to use metacognitive strategies when approaching a totally new area. He uses the "dark room" as a metaphor, meaning that it is easier to find the way during a break in the electric distribution if we are familiar with the room than in a totally new room. Suspicions like these underline the need to build up the capacity of a reader to understand a text in advance.

As an author does not have the possibility to anticipate all the questions a reader might have, information could shortly be presented in advance. The aim with advance organizers is to equalize differences in knowledge, hence optimizing the possibilities to understand texts.

Questions, as one type of metadiscourse, can be beneficial for comprehension by activating and focusing the attention of the reader. Questions can for instance explain the aim of a chapter through an initial wondering about an actual theme. Speaking with Marton (2000) one could also say that the reader is directed from superficial reading to an active reflection about the message of the author.

The quality of the questions is important. If the answer is easy to find in the text the learning can, as for instance Marton (2000) has shown, be tecnified. This means that the reader is reading the text just with the purpose of finding answers to the questions in the text and thus processing the text superficially. If the content is problematizated the activity of the reader can be enhanced. This can be the first step in trying to transform the misconceptions of the reader and more generally to guide a novice reader into a new area. They have too little knowledge about most subject areas to ask the significant questions themselves.

To sum up, the maxim of metadiscourse underlines the need to direct readers through texts. Emphasis should be put on the difference between directing and manipulating. The sentence mentioned above, "*You know that the molecules in liquid water are constantly moving*", certainly directs the reader but it does not, however, give the reader any chance to take a stand. In fact at least in the Finnish context texts that question the information presented seems to be rather scarce in textbooks (e.g. Mikkilä-Erdmann et al 1999; Hohti & Lehto 2001). This leads us to the next maxim.

Conflict

According to Crismore (1984) textbook writers have had a deliberate or non-deliberate passive view of the reader. The pupil is supposed to receive facts from the all-knowing authority who wrote the texts. The textbooks' own authority as written medium contributes to this process. We are used to finding the "truth" in texts. There are no such possibilities to question a book as there are to question a person who is speaking. To deal with this problem transparent texts, showing the presence of the author could be constructed for instance by using metadiscourse.

We are used to finding the "truth" in textbooks. A passive approach can result in memorizing activities rather than critical reading. It is important that the reader gets possibilities to reflect on the content. The strong institutional authority of the textbook motivates a relative stand in choosing content for textbooks. A textbook author needs to be aware of a paradox consisting in "disregarding" the personal knowledge when aiming to entice the reader to draw his or her own conclusions.

Especially within research on science learning the possibility of developing misconceptions has been highlighted. When building an interpretation of the surrounding world children are influenced by the everyday culture and everyday language. As a result explanatory frameworks are constructed that often are different from currently accepted scientific positions. Because of this the process of learning science appears to be slow and gradual. Elements of scientific theory are assimilated to initial explanatory frameworks. Pupils stick to their naive beliefs about scientific phenomena, even if they have been taught a scientific view at school. Vosniadou (2004) underlines that the scientific explanations of today have developed over thousands of years of scientific discovery and therefore have become counter-intuitive theories differing largely from our initial explanations and everyday experience. Based on different views of what constitutes intuitive theories, there are different views of what will promote a conceptual change. Vosniadou (2004) finds support for a slow transition, as the conceptual change involves ontological changes, for instance as concepts in physics are wrongly considered as substances instead of processes. The writers of considerate texts should therefore pay attention to the apparent problems there seems to be when learners' every day views are confronted with scientific interpretations.

According to Mikkilä-Erdmann (2001), there is little research about how texts affect the preconceptions of children. This is rather surprising because of the significant role given to pre knowledge. At young age the child builds up a view of how the world is functioning. Once in school pupils are usually not aware of the conflict between their old knowledge and the one presented at school. Consequently, there is a problem when themes such as evolution or photosynthesis are to be explained. Mikkilä-Erdman (2001) has shown that it is possible to change the presuppositions of the young readers. According to

the principle of *conflict* pupils should be given possibilities to test if new information suits their earlier knowledge or if it is contradictory to it.

The results from the study of Mikkilä-Erdmann show that different texts foster different kinds of learning. A traditional text gave good results when the readers were supposed to find facts in the texts. A text conflicting the supposed misunderstandings resulted in better achievement when the readers were supposed to draw conclusions based on the information in the text. The following example of a refutational text first presents a misunderstanding and after that gives the correct explanation to a problem (from Guzzetti, Snyder & Glass 1992, 646):

> The most popular belief about ostriches is that they bury their heads in the sand in the hope that their enemies will not notice them. Ostriches may well listen intently for sound with their heads near the ground. They may even lower their heads to rest their neck muscles. But if they buried their heads in the sand, they would not be able to breathe.

According to Limón (2001, 357-380) it is, however not enough to present the conflicting data because pupils can react in many different ways to the data, for instance by ignoring it, by repudiating it or by changing the theory. If the text does not engage the reader a meaningful conflict does not evolve. According to Adey, Shayer and Yates (1995) the use of cognitive conflicts can have less effect than predicted because the child knows so little about a subject area that there cannot be anything enough surprising to be considered as a conflict.

The children also should be given a possibility to confront their old beliefs. For this, instructions in the form of metadiscourse are needed. An argumentative text where a scientific view is compared with a potential misconception is needed.

In argumentative texts the author tries, by presenting arguments in favor and against an issue, to give the reader a possibility to build his or her own interpretation. Research conducted by Rantalainen (1991) shows that textbooks have not usually used a multiple perspective way of writing. Authors did not question their presentation by giving two or more explanations to a phenomenon.

Another way of directing young learners to scientific information is to emphasize the change within science. As change rather seems to be a rule than an exception in the development of science (Säljö 1997; Tsai 1998) introducing a new concept can mean taking the pupil on a journey through scientific inquiry, and at least presenting some of the stops on the route. A scientist tries to see reality from new and earlier unknown perspectives. Although a pupil has to encompass the actual interpretation of the scientific community, putting him or her in a similar position as a scientist may enhance

activity. For instance instead of giving the formula for photosynthesis in the beginning of a presentation the readers could, as in a Norwegian example (Guldbrandsen & Tanggaards 1998), be confronted with old conceptions in science. There are of course risks with underlining old concepts in too much detail. Confusion may follow (Smith 1992).

Finally also textbooks in a school setting could state that it is impossible to give a simple answers to certain questions. According to Vähäpassi and Takala (1986) this kind of writing is rare. Authors hardly ever use expressions like: ”*It is probable that...”,* “*According to this interpretation* …,” “*One does not know for certain* …”.

We can assume that it is easier to use a style like this in areas where the author presumes that there is no certain knowledge. von Glaserfeld (1995) writes, what is today considered as knowledge, tomorrow can be seen as misinterpretations. “Facts” are seldom perennial. It is possible to activate the reader by giving her or him the possibility to be engaged in the knowledge production because of the need to decide to which degree a “fact” is a “fact”. From a learning perspective it can be motivated to consider textbooks as historical artifacts that sum up some generally accepted conceptions during an epoch.

To sum up the maxim of conflict, the need to confront the possible misinterpretations of the (young) readers should be taken into consideration. Although this could be done in various ways, an apparent need for textbook writers to inform themselves about variation in learning within their field of expertise is obvious.

Conclusion

The extensive use of textbooks in different parts of the world emphasizes continued efforts to develop knowledge about how good learning texts could be written. To sum up, it must be considered essential in writing learning texts to reach the reader at his/her level of understanding (the maxim of *optimizing*). It has been claimed that textbooks inherit textbooks, meaning that textbook writers are so bound to the genre that they copy the way of writing from other textbooks. This could create problems for understanding as the genre per se could have developed incomprehensible ways of exposing facts. One concrete way of dealing with this problem, practiced by the writer of this

article, is to use potential readers of actual age as referees. To make sense texts also should be well structured. This is especially important as learners in school settings mostly approach new areas as novices (the maxim of *structure*). The readers should be made aware of the structures in the texts by signals provided by the authors (the maxim of *metadiscourse*). By doing this, the activity of the reader can be ascertained. Especially within the research on science education there are results from a long period of time showing the problems in learning core concepts like gravitation, photosynthesis and the movement of light. These problems emphasize the need to confront learners with possible misinterpretations and to present facts exposing different angles (the maxim of *conflict*). As all learning is embedded in the psychodynamics of the individual, textbook writers should continually ask themselves how to reach the life world of the reader (the maxim of *pleasure*). This could be made by choosing ways of presenting information close to the readers' earlier experiences and by choosing content with potentials to engage.

Writing, also of textbooks, must be considered an art. It is therefore not possible to construct a formula for good writing applicable to the individual work of authors. In the end the creativity and the intuition of the single writer shape the text. A continued discussion about how results from research on learning can be exposed in textbook writing is necessary. More maxims are to be defined.

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