OUTLINES - CRITICAL PRACTICE STUDIES

Providing an orientation basis for a young blind reader's structuring interaction with expository texts

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Abstract

The interventional case-study presented in this report was intended to explore how the use of a conceptual meta-model representing coherent and conceptual relations commonly appearing in expository texts helped a blind reader to use structuring strategies in reading them. The instructional approach designed and tested in the study was based on the key elements of the theory of planned stage-by-stage formation of mental acts and concepts (PSFMAC), introduced by Galperin, and also drew on contemporary approaches in reading comprehension interventions. The participant of the study was a 17-year-old, blind man with semantic and syntactic disorders in his early language development. The results of the study indicate that the use of the developed conceptual meta-model appeared to considerably affect his strategies in structuring the expository text content. During the intervention, the participant started more accurately to take account of some frequent coherent and conceptual, particularly causal, relations that he was previously prone to ignore. He also started more actively to use external speech while reading. The results provide evidence that the developed conceptual meta-model can serve as an external organizer helping a blind reader to actively structure text content.

Keywords

Blindness; reading; language development; conceptual meta-model

Introduction

Youngsters with impaired perceptual functions and various cognitive weaknesses pose a particular challenge to scaffolding and instructional practices that aim at dealing with reading comprehension problems. In order to prevent these students from being marginalized in increasingly demanding learning contexts, educational practices should be created to help them to compensate for their functional weaknesses by means of adaptive reading strategies. Of particular interest in this regard is determining what kind of strategic activities are most useful in scaffolding visually impaired readers' text processing, to remedy comprehension deficits.

A specific challenge inherent in a blind reader's text processing is the lack of opportunity to lean on such highly visual strategies as preliminary eying, looking for bolded or italicized expressions, or creating conventional mind maps. If a reader, in addition, is blind from an early age, the lack of visually processed information is prone to hamper his or her efforts to acquire general knowledge, which in turn inevitably affects reading comprehension. It thus appears plausible that a blind reader is in need of specially tailored compensatory reading comprehension strategies enabling systematic processing of text content. In what follows, we elaborate a number of theoretical and methodological notions as well as concrete pedagogical solutions for fostering blind readers' structuring activities in text processing. Finally, we present our study focusing on the use of an external conceptual model in guiding a blind reader's text processing activities.

The role of structuring activities in text comprehension

Young readers' various *elaboration and organization* strategies have been found to play a crucial role in processing expository texts, particularly when they are extracting information from multiple sources (Bråten, Strømsø, 2003; Cotè & Goldman, 1999; Strømsø, Bråten & Samuelstuen, 2003; Wolfe & Goldman, 2005). The interventional approach explored in the present study aims to support young blind readers in *building coherent mental representations* of the expository texts that they read.

Some conceptual approaches have shed light on internal cognitive mechanisms and functions related to reader's active attempts to build representations and meanings about what is being read (Kintsch, 1988; 1998; Gernsbacher, 1990; 1997).

The Construction-Interaction model introduced by van Dijk and Kintsch (1983) distinguished two forms of representations constructed by a reader from text content: the text base and situation model. The *text base* is a hierarchical propositional representation of the text content. It consists of those elements and relations that can be directly derived from the text itself and contains both micro- and macrostructures. The microstructure represents the sentence-by-sentence information included in the text whereas the macrostructure represents the global organization of the text. The macrostructure is derived from a text through the deletion of less important portions of the text, generalization of instances and construction of summaries of events (van Dijk, 1980). A *situation model* is a construction that integrates the text-base and relevant aspects of the reader's knowledge (Kintsch, 1998) and is based on inferences and interpretations that a reader makes in text-processing.

The Structure Building Framework (Gernsbacher, 1990; 1997) posits that building a coherent mental representation or structure representing text information involves three

key processes. First a reader *lays a foundation* for a mental structure, then *maps* coherent information onto the developing structure and *initiates a new structure* if incoming information cannot be integrated into the existing structure. In mapping, readers interpret the cues that provide signals about coherence between various parts in texts on the basis of their knowledge on events, entities and relations in the world as well as on the language used to communicate about the former.

Drawing on the notion of critical role of the coherent mental representation of text in reading comprehension, the interventional approach in the present study highlights the role of readers' goal-directed actions in building these representations. Graesser (2007) defined *reading comprehension strategy* as *a cognitive or behavioural action* that is enacted under some contextual condition with the goal of improving some aspect of understanding. This notion in many respects parallels the understanding of mental activities, in general, in the framework of Activity theory (Elkonin, 1989; Galperin, 1992; 2002; Leontiev,1957; 1981; Talyzina, 1983; Zhaporozhets & Elkonin, 1983). On the basis of the findings from their studies, Vygotsky, Leontiev and Luria in the 1920s had already concluded that the development of higher intellectual operations is based on the mastery of societally evolved symbolic sign tools. Leontiev and his scholars (Elkonin, 1989; Galperin. 1992; Leontiev, 1957; Zhaporozhets & Elkonin, 1983) later expanded the notion of cultural learning to involve, as well, the acquisition of the system of *human actions and their meanings* mediated by various symbolic sign tools in learning activity.

In a learner's activity, Elkonin (1989) distinguished *practical actions* directed to external objects and learning actions mediated by particular learning tasks and directed to the acquisition of specific means and forms of actions. Leontiev and his successors pointed out that developing intellectual operations such as generalizations and causal reasoning are malleable skills and that their development is highly determined by the character and structure of a subject's external activity. They demonstrated that these kinds of skills can be shaped by organizing children's external actions; that is, learning actions in a way that prompts children to establish and analyze essential properties of objects and relations between them.

Piotr Galperin (1992, 2002; Liders & Frolov, 1991; Podolskij, 1997, 2002) is one of the most prominent representatives of Activity theory school in the psychology of learning; he introduced the concept of *orienting activity*. It refers to a subject's attempts to build a mental image of the objects and problem situations related to his or her activity.

Applied to the analysis of readers' structure- and image-building attempts, the framework of Activity theory can be understood as suggesting that related mental processes are amenable to externalisation and are mediated by various sign-tools, both internalized and externalized. Consequently, the use of external sign-tools should be seen as part of practices aiming to foster readers' structure building actions.

Fostering blind readers' structure building actions by means of an orienting basis

The utilization of a text structure can be viewed as posing a specific challenge to a blind reader for a number of reasons. Braille readers have to devote more resources than in print reading to word-level processes, and they do not perform sentence and text integration at sentence and paragraph boundaries (Carreiras & Alvarez, 1999). Blind readers are also not able to use visual strategies (preliminary eying, creating conceptual maps or diagrams) in their attempts to build mental-images of the texts that they process. Blindness thus can be

assumed to constitute a factor that increases a reader's cognitive load, particularly in processing texts on unfamiliar topics requiring continuous monitoring of the relations between diverse elements of the text content.

Given blind readers' limitations in processing text-structures, it appears legitimate to develop guiding tools and techniques that help them to integratively process various local and global structures in expository texts. From the perspective of an Activity theory framework, a crucial question in this respect is how the structuring and modelling of a blind readers' activity as well as its object is addressed in a pedagogical intervention (Kosonen & Hakkarainen, 2007). To outline a learning intervention as a system that makes explicit the structure of both learning activity and its object for a learner, Galperin developed a specific pedagogical framework, *the theory of planned stage-by-stage formation of mental acts and concepts* (PSFMAC). It gives a description of four subsystems of a pedagogical intervention, allowing optimal learning results to be achieved in respect of a learner's motivation, orientation, operational mastery and internalization. An overview of this framework is given in previous publications (Kosonen & Hakkarainen, 2007; Kosonen, Lakkala & Hakkarainen, in press). The present study focuses on the development and testing of a conceptual model used in the formation of a blind reader's structure building actions, based on the second subsystem of PSFMAC-theory. This subsystem is meant to provide the conditions that are required for building learners' actions or their orienting basis in a learning intervention.

The concept of an "orienting basis" in the PSFMAC refers to a system of modelling instructions needed in shaping a required action at the desired level of proficiency. The orienting basis comprises a generalized representation of the problem situation and the adaptive forms of activity related to it. The orienting basis is often drafted in the form of an external physical model that structures the participant's activities. In its widest form, an orienting basis not only defines necessary properties of the action to be formed but also involves a model of essential structures and internal connections of the object or problem situation to be addressed by the learner.

If we consider the processing of expository text as a problem situation in which an orienting basis should help a blind reader to structure text content, it is important to define the target actions as well as the object or objects being modelled in the orienting basis. Based on the contemporary models of reading comprehension, the text content and its mental model (text-base) as well as a reader's world-knowledge (situation model) related to the text topic can be regarded as objects addressed in the structure building actions. In addition, the intervention and the orienting basis should promote *learning actions* contributing to the acquisition of various ways of text structuring in reading.

Among the existing interventional approaches, some solutions, particularly Structure strategy training (SST; Meyer & Poon, 2001; Meyer & Wijekumar, 2007), Text-Structure-Based Strategy (TSBS; Bakken, Mastropieri & Scruggs, 1997) and Texas Christian University Node-Link Mapping (TCU-NLM; Dansereau, 2005; O´Donell, Dansereau & Hall, 2002), orient learners to build knowledge structures based on text-contents and their world knowledge by means of *various culturally evolved textual means of knowledge structuring*. These solutions provide trainees with modelling conceptualisations that reflect essential structures and internal connections of the text-contents (for instance, the main idea, list, definition, description, sequence, causation, problem, classification). The use of these training approaches has been found to promote comprehension and memory

of texts in young and older adults (Meyer & Poon, 2001; Meyer, Talbot, Poon & Johnson, 2001) and also to benefit students with learning disabilities (Bakken, Mastropieri & Scruggs, 1997). These approaches, however, have not been modified to be suitable for blind readers.

Aims of the study

The main purpose of the present study was to explore how the conceptual meta-model, developed in previous studies (Kosonen & Hakkarainen, 2007; Kosonen, Lakkala & Hakkarainen, in press), can be used as an orienting basis in facilitating a young blind reader's structure building actions. The study aimed to contribute to the development of an external interventional tool that could be used in conjunction with existing approaches in blind readers' strategy training.

The developed conceptual model parallels the modelling solutions used in the SST, TSBS and TCU-NLM -approaches. The design of the model was also based on the notion that an orienting basis, intended to foster the reader's structure building actions, should somehow reflect both the text-structure and the structure of a reader's topic-related world knowledge. Consequently, our aim was to explore how the guiding instructions explicating both the text structure and the generic conceptual relations structuring world knowledge could be consolidated into one model.

The study focused on examining how the separate elements of the conceptual model served as *scaffolding affordances* mediating the participant's structure-building actions in processing text contents. The concept 'scaffolding' in this context refers to an act of guidance that supports the immediate construction of knowledge by the learner but also provides the basis for the progressive relocation of scaffolding agency from teacher to learner (Holton & Clarke, 2006). This definition of the concept 'scaffolding' is thus more focused than the well-known definition by Woods, Bruner and Ross (1976).

The following research questions were formulated:

1. How did the use of the model and related guidance immediately affect the participant's ways of structuring text content in reading?

2. What kind of difficulties did the participant display in using the model to structure text content, and how did the use of the model in turn help to alleviate these difficulties?

3. How did the participant start spontaneously to use the elements of the conceptual model in structuring the contents of various expository texts?

Method

Methodological approach of the study

The present exploratory case study was a qualitative-based investigation of the use of a particular, conceptual model within the context of an individual reading strategy intervention with the participant, who had specific educational needs. Yin (2003) defined case study as an empirical method examining "a contemporary phenomenon within its real life context". Qualitative research is a research methodology that strives to investigate, understand, and give meaning to a particular case, setting, characteristic, or event (Denzin

& Lincoln, 2005). Such research methodology opens up an opportunity to deepen the understanding of the needs and challenges experienced by individuals with disabilities in their daily environments (Brantlinger, Jimenez, Klingner, Pugach & Richardson, 2005).

The investigated target phenomenon was the guidance provided by the conceptual model in helping the participant to structure text content in reading. The real life context of the study was the participant's learning environment at his home, where the intervention mainly took place, and involved the learning assignments related to his vocational training as well as his content-related interests.

Context and participant

The present study focused on the initial part of a text-processing intervention with a young blind reader. The participant was a 17-year-old man who studied in a specialized, piano technician program at a vocational institution for the learners with visual and hearing impairments. He had lost his sight after an extremely premature birth that took place in the 25th week of the pregnancy, due to the side-effects of oxygen treatment. Extremely early birth has been found to constitute a health risk exposing a newborn baby to neurologically based developmental problems manifesting in various learning difficulties throughout the lifespan.

At the age of five, the participant was found to have semantic and syntactic disorders in speech and language development and was referred to speech therapy that lasted until the end of the junior high school. According to the speech therapist's assessment, the participant displayed problems in linking new information to his prior knowledge. He was not particularly interested in reading, and his spontaneous reading activities in leisure time were, as a rule, limited to the browsing of various websites searching for information about his favourite pop groups.

The participant and his parents agreed to his participation in the study because he needed support in processing various texts related to his studies as well as in completing assignments requiring him to produce essay-like texts.

Conceptual model used in the intervention

The conceptual model used as a scaffolding tool in the intervention consisted of the following 14 meta-markers that reflect various generic ontological categories and relations frequently used in expository texts in presenting knowledge on their target topics.

    I.   Definition
    II.   Causes, affecting factors
    III.   Purpose, tasks
    IV.   Activity, functioning
    V.   Examples
    VI.   Properties
    VII. Parts, structure
    VIII. Consequences
    IX.   Forms of occurrence, types
    X.   Regular phases
    XI.   Historical phases, phases in the future
    XII. Location, places of events

    XIII. Ways of getting knowledge (about a topic)
    XIV. Frequency

Since the model had to be tailored to fulfil the participant's individual needs, three versions of it were launched in the intervention in order to find the optimal solution.

The first version was used during the phase of initial training in the introduction (see Appendix 1). It was drafted on a poster-like paper sheet into the form of a clock-board-like schema, since blind children and youngsters are usually guided spatially by means of the coordinates of the clock-board. The clock-board model contained 12 paper slips each with a heading typed with Braille and referring to one meta-marker (I-XII). The order of the meta-markers was selected so that the two of them referring to the causal coherence relations (II and VIII) were placed at the opposite end of the horizontal axis of the board. A paper slip with the headings: "Main thing" referring to the target topic was placed at the centre of the board. Each meta-marker-slip was linked to the target topic-slip with a touchable tape strip. After the first session, the 12 meta-markers featuring the first session were converted into a set consisting of separate cards with Braille headings. These cards were used during interventional sessions 2-5.

In the fifth session, rehearsal of the use of the meta-markers took place in conjunction with the drafting of the second, *a tailored digital version* of the conceptual model in the form of an electronic text file. It consisted of the headings of meta-markers and related notes including generic questions, formulated together with the participant, elucidating the meanings of the meta-markers (Appendix 2). In addition, two new meta-markers, XIV (Frequency) and XIII (How is the main thing investigated?) were introduced to the participant and added into the text (the title was changed later).

Finally, a third, *generic digital version* of the conceptual model was developed, meant to facilitate the identification of linguistic markers expressing various coherence and conceptual relations in texts. For this purpose, the version included a set of additional generic questions, and separate examples of words and expressions that often signal the presence of such relations corresponding to the meanings of the diverse meta-markers (see Appendix 3).

General research procedure

The investigated interventional process covered 20 sessions that lasted approximately one hour each and were held every 2-3 weeks.

The interventional activities during the first five sessions mainly served as initial training exercises acquainting the participant with the use of the conceptual model in elaborative questioning and structuring text processing. In this phase, only separate, short text fragments were processed. The activities during the rest of the 15 sessions involved working on longer and coherently organized texts.

The topics of the texts fell into two main categories. The first category was immediately related to the essay-like assignments that the participant received while attending the vocational training. Those topics were mainly processed by means of elaborative questioning (see section "Intervention process"). The topics captured such issues as "Allergies", a review of the released album of the participant's favourite pop group, and "Tuning".

The second category of texts and textual fragments was selected by the intervener and served as training material for both elaborative questioning and structuring text processing. As a rule, these texts concerned issues that did not immediately fall within the scope of the participant's educational interests. Their topics were related to such issues as "Learning motivation", "Violin" and "Students' care service".

Intervention process

The first session of the intervention focused on the participant's acquisition of the conceptual meta-model and on the evaluation of how he initially perceived and reflected on various coherence and conceptual relations in texts. The participant was exposed to the initial version of the orienting basis consisting of 12 conceptual meta-markers. The meaning of each meta-marker was clarified by posing examples of how the coherence and conceptual relations represented by them might appear in various contexts. Subsequently, the participant was asked to generate questions on the text topic "London and its history", first, without assistance and then by exposing him to each meta-marker with the request to try to come up with questions related to the meta-markers that the he found suitable to the topic. The intervener clarified, with supplementary examples, the meanings of the meta-markers that the participant did not apply in questioning although they would have been relevant to the text-topic.

After the question generation, the intervener read aloud the target text, in fragments, and asked, to which of the meta-markers each fragment could be linked. The participant's attention was drawn to the sentences that he did not link to the potentially suitable meta-markers. The participant was allowed to touch the model and read the paper slips glued on it. If he could not find a suitable meta-marker, the intervener repeated the content of these sentences in his own words, referred to the meta-markers that they could be linked to and asked the participant whether he could make sense of the link between the sentences and the meta-markers named.

The interventional activities during the rest 19 sessions split into four main types. Two or more of these types were present in all sessions.

1) *Elaborative and predictive questioning*: The participant was exposed to the meta-markers, asked to recall them and to generate questions on the topic firstly without assistance and then by means of the meta-markers.

2) *Structuring text processing*: The participant was exposed to text-fragments with a request to find the meta-markers that reflect the coherence or conceptual relations featuring these fragments. Then he was asked to think of other suitable meta-markers if the intervener considered the use of multiple meta-markers relevant in defining the targeted relations and to reconsider his choice if the intervener regarded it as inappropriate. In addition, the participant's attention was drawn to a particular text fragment or expression suitable to be linked to the meta-marker not considered in his previous response. In some cases, the intervener asked the participant to go over the conceptual model or exposed him separately to one or a limited set of meta-markers.

3) *Structuring recall*: This type covered episodes during which the intervener requested the participant to try to recall processed text content, firstly, without assistance and then by leaning step-by-step on each meta-marker. The purpose of the structuring recall activities was to provide examples of how the meta-markers as well as the coherence and

conceptual relations represented by them can be used as a conceptual framework for organizing text-based knowledge that is extracted from memory.

4) *Reflecting on and discussing general text processing strategies*: Besides the interventional activities immediately related to the use of the meta-marker, several general text processing strategies were discussed, such as reading the topics, sub-topics and the first sentences from each paragraph of target texts. The purpose of this guidance was to foster the use of the meta-markers integratively as an action pattern serving other text processing strategies.

Data collection

Data analyzed in the study were collected from the first session and sessions 6-20. The sessions 2-5, during which the initial training took place, were left out from the analysis. Raw data consisted of the transcribed video-recordings of the sessions, the notes that the participant typed during these sessions, and the intervener's observation notes.

Data analysis

General structure of analyses was such that the first session was analyzed separately focusing on how the participant, first, without assistance and then when assisted with the initial version of the model, predicted the presence of various coherence and conceptual relations in texts and explicated them in reading. The purpose of this analysis was to evaluate the participant's initial awareness on these relations. With regard to sessions 6-20, a qualitative content analysis by means of Atlasti-software was conducted on those sections that were regarded relevant for answering the research questions. The analysis in general was limited to the following activity patterns:

- The participant's responses to the intervener's guiding actions during structuring text processing activities;
- The participant's responses while using the conceptual model externally during these activities;
- The participant's spontaneous actions and verbalization related to the elements of conceptual model during structuring text-processing activities.

The first and second analyses focussed on the participant's first responses to the intervener's requests. They were conducted to explore how the use of the model in the intervention immediately affected the participant's text processing. The first analysis focused on the participant's responses in each session to the intervener's *initial requests* to find the meta-markers that reflect the coherence or conceptual relations featuring text-fragments. The responses were classified into the following categories:

a) Linking a text content to a one or multiple meta-markers,
b) Reflecting spontaneously on the text-content on the basis of conceptualization related to a separate meta-marker,
c) Looking over, spontaneously, the conceptual model,
d) Linking an element of text-content to some meta-marker after browsing,
e) Reflecting spontaneously on text-content on the basis of the conceptualization related to the selected meta-marker.

The second analysis addressed the participant's responses to the intervener's *subsequent requests* to consider still other meta-markers. Only those responses that involved new linking solutions or referred to the elements of text-content that the participant had not addressed in his previous response were analyzed. The following classes were implemented in this analysis:

f) Coming up with another or supplementary linking solutions,
g) Reflecting spontaneously on the text-content on the basis of conceptualization related to the new linking solutions,
h) Coming up with another or supplementary linking solutions while spontaneously browsing the conceptual model or browsing the model according to the intervener's request,
i) Reflecting spontaneously on text-content on the basis of conceptualization related to the model.

The third analysis aimed to shed light on what kind of difficulties the participant encountered in linking the processed text contents to the elements of conceptual model; and how the intervener's guidance and the active consideration of the model led the participant to new linking solutions.

The analysis firstly focused on what kind of coherence and conceptual relations the participant was prone to ignore while he was supposed to come up with linking solutions and how the browsing of the conceptual model affected linking. The participant was interpreted as not seeing a particular relation if, after the intervener's prompting request following his first linking solution, he did not link related text content to the meta-marker that apparently captured the meaning of that relation. The other criterion was that the intervener addressed the relation in his subsequent guiding actions.

Secondly, the analysis of difficulties focused on 1) the outcomes of the intervener's guiding actions drawing the participant's attention to the previously ignored relations and 2) the elements of the conceptual model that affected the participant's reconsidered linking solutions in browsing.

The last analysis aimed to capture how the participant spontaneously used the conceptual model in reading text content and how this spontaneous use of the model changed during the intervention. The analysis was limited to the sessions during which the participant himself read text-fragments before he undertook to link various elements of the content to separate meta-markers. A total number of 6 sessions met this criterion. In order to provide sufficient intervals between analyzed sessions to make possible changes observable, the first and last two of these sessions (14, 16, 19 and 20) were selected for the analysis.

The linking episodes of these four sessions were analyzed to find all possible cases in which the participant spontaneously, and in his own way, used the model or its elements in text-processing. The following action types were established and selected as analytical categories:

1. Browsing the model in linking,
2. Reflecting on text content in browsing by using the conceptualizations related to the meta-markers,
3. Linking without the assistance of the model,
4. Reflecting on the text-content using the conceptualizations related to the meta-markers (without using the model externally),

5. Reflecting on the conceptualizations of the model.

The frequencies of these classes in the four analyzed sessions were compared to reveal possible changes in the participant's responses.

Results

The participant's initial awareness on the coherence and conceptual relations featuring expository texts

During the first session, the questions generated by the participant, without assistance, on the text topic "London and its history"concerned the time of the founding of the city and construction its landmarks. After being exposed to the initial version of the conceptual model, the participant associated a new question, "What is London like as a city" to meta-marker VI (Properties of the phenomenon). Such topic-relevant meta-markers as II (Causes of the phenomenon, factors affecting it) and III (Purpose and function), however, did not help the participant to generate new questions. While the intervener read aloud the fragments of the text and asked the participant to link them to a particular meta-marker, he repeatedly referred to the meta-marker XI (Historical phases).

The participant was not able to link the meta-markers II (Causes, affecting factors) and III (Purpose and function) to the sentences describing how the ancient Roman troops built a bridge over the Thames river in the contemporary location of the city, founded an administrative center and named it "Londonium". When the intervener drew the participant's attention to the sentence, "The booming rise of the trade and industry raised London to one of the biggest and richest cities of the world," he linked it to the meta-marker VIII (Consequences).

These findings from the participant's first session demonstrate that he was prone to structure the text content on the basis of phases of time course and apparently paid less attention to causal coherence relations between the text topic and the separate elements of its content.

Immediate influence of the use of the conceptual model on the participant's ways of structuring text content

The first exposures to text-fragments along with a request to find the meta-markers most closely corresponding to their meaning led to a total number of 164 participant responses interpreted as effects. Table 1 lists the diverse types of responses that the participant gave.

Table 1. Types of responses by the participant

Type of response	Number of cases
a) Linking a text content to a one or multiple meta-markers	89
b) Reflecting spontaneously on the text-content on the basis of conceptualization related to a separate meta-marker	49
c)Looking over, spontaneously the conceptual model	10

d) Linking an element of text-content to some meta-marker after browsing	8
e) Reflecting spontaneously on text-content on the basis of conceptualization related to the selected meta-marker	8

The intervener's requests prompting the participant to think of other suitable meta-markers resulted in the types of responses summarized in Table 2.

Table 2. Types of participant responses after the prompting requests

Type of response	Number of cases
f) Coming up with another or supplementary linking solutions	38
g) Reflecting spontaneously on the text-content on the basis of conceptualization related to the new linking solutions	13
h) Coming up with another or supplementary linking solutions while browsing{looking over} the conceptual model	13
i) Reflecting spontaneously on text-content on the basis of conceptualization related to the model	11

Difficulties found in the use of the model

The further analysis of the participant's linking solutions established which of the meta-markers were mostly ignored by the participant in linking although they were relevant to it, given the content. The analysis revealed that the participant most frequently did not use the meta-markers II (Cause/Affecting factors), X (Regular phases), and I (Definition) in processing text fragments although these meta-markers suited the content of these fragments (see Table 3). For instance, concerning meta-marker I (Definition), the participant ignored it when he came across to a particular Finnish expression in defining various phenomena. This expression is formed by using the passive form of a verb "refers to" (tarkoitetaan) that derives from a noun tarkoitus having a meaning "purpose". The participant was found to be prone to link it erroneously to the meta-marker III (Purpose). For other meta-markers, the relative proportion of ignoring responses was low.

Table 3. Meta-markers most frequently ignored in linking

Meta-marker	Fragments to which the meta-marker would have suited	Correct linking solutions	Errors of linking due to ignorance
I Definition	9 (100%)	6 (66%)	3 (33%)

II Causes /Affecting factors	14 (100%)	8 (57%)	6 (43%)
X Regular phases	9 (100%)	3 (33%)	6 (67%)

Influence of the use of the model on the manifest difficulties

The analysis revealed that in 26 guiding episodes, the intervener drew the participant's attention to the ignored coherence and conceptual relations. A total number of 20 of these episodes resulted in the detection of the previously unnoticed relations. The detection took place when the participant was prompted to think of a new solution, one or more times.

The data analysis revealed a total number of 21 text structuring episodes during which the participant's spontaneous or requested external use of the conceptual model affected his linking solutions. For instance, the participant linked the sentence "When a violin is played, its trunk vibrates" to the meta-marker IV (Activity/ Functioning) in browsing the model.

 Besides general headings of the meta-markers, the generic questions inserted in the model also affected the linking solutions. For instance, the question "What is the origin of the thing?" helped the participant to understand that the sentence "Controversies in knowing give rise to a learner's learning motivation" refers to the cause (meta-marker II) of the topic phenomenon.

The analysis revealed that various elements of the conceptual model in conjunction with the intervener's guidance prompted the participant to re-represent processed text materials by organizing their content into topic-centred propositional macro-structures. They were also found to help the participant to pay attention to some conceptual and coherence relations that he did not address without assistance in his linking solutions.

The participant's spontaneous use of the conceptual model in structuring text-content

The content analysis of the linking episodes during the sessions 14, 16, 19 and 20 revealed apparent transformations of the participant's ways of spontaneously using the conceptual model or its separate elements in structuring text content while reading texts. The findings of the analysis are presented in Table 4; these regard the participant's actions related to the use of the conceptual model including the frequencies of diverse action types and related examples.

Table 4. Ways of spontaneously using the model in sessions 14, 16, 19 and 20.

Ways of using the model	S14	S16	S19	S20
Browsing the model in linking	5	0	1	0
Using a meta-marker in summarizing text-content while browsing	11	2	0	0

Linking without browsing the model	3	7	8	7
Using meta-markers in summarizing without browsing the model	1	2	9	4

Thus, during the majority of the linking episodes in the 14th session, the participant went over the conceptual model spontaneously after having read a text-fragment, linked the parts of fragments to separate meta-markers and in many cases briefly summarized the parts being linked in browsing. For instance, when the participant came across to the meta-marker IX (Forms of occurrence) in processing a text about violins he stated: "One would say here that there exist the ordinary violin and viola".

In the 16th session, the participant did not look over the model at all but linked separate parts from the read text-fragments to various meta-markers without its assistance; however, he summarized the part being linked only twice. In the 19th and 20th sessions, the participant summarized separate parts of the text-fragment more frequently than in the first two analyzed sessions without the assistance of the model while linking them to separate meta-markers. For instance, in the 20th session, in coming across the sentence: "State budget refers to a plan regarding the administration of state assets" he said: "That's sort of definition isn't it, what a budget refers to."

The findings appear to indicate a certain tendency towards partially internalized use of the meta-markers and related conceptualisations in structuring text content.

In addition to the findings presented above from linking episodes, the content analysis of sessions 14, 16, 19 and 20 captured a number of the participant's verbalisations (n = 14) functioning as reflections on the conceptualisations of the model. They focused on separate conceptual links within the model and appear to indicate the participant's efforts to remember them. Some of the reflections concerned the linguistic expressions that the participant had previously not been able to associate with the meta-markers corresponding to their meanings. The following example is from the 19th session:

Participant: "What brings them about?"
Intervener: "The emissions of carbon-oxides, yes indeed"
Participant: "Is that a sort of cause?"

An interesting separate observation was that the participant, a number of times, tried spontaneously to remember which of the meta-markers the expression "What does it refer to?" is linked to in the conceptual model before he correctly interpreted it to signal the presence of definitional information in the 20th session. This finding, together with the participant's other spontaneous reflections (some quoted above) on the conceptualisations of the model, indicates that he made attempts to make sense of the meanings of various linguistic markers that he was exposed to in using the model.

Discussion

The results of the study demonstrate that a digitalized conceptual model, based on the typical coherence and conceptual relations of expository texts, can serve as an interventional tool helping an intervener to promote a blind reader's active engagement with a text and his active structuring of its content. However, if a learner has other difficulties besides blindness in processing various linguistic expressions, the use of the model requires a tailored approach that takes account of his specific needs and weaknesses. In the present case, the participant was not able to make use of simple unclarified link-types represented by the meta-markers of the conceptual model used at the initial stage of the intervention. The subsequent versions of the model were supplied with various guiding questions and examples of the expressions illustrating how these link-types are represented in expository texts; these additions were found to be more helpful to him when he tried to structure text content. The use of the model appears to open up an opportunity to help raise a reader's *awareness* of the coherence and conceptual relations and their linguistic expressions regularly used to organize content in these texts.

The conceptual model was used in guiding the participant to structure text contents into units being linked conceptually to the main topics of the texts; this approach appears to have prompted him to reflect on the meanings of the separate parts of the texts immediately in reading. The model provided the participant with explicit criteria for summarizing the separate parts of text content in relation to the text topic. In a number of cases, the conceptual elements of the model in conjunction with the intervener's guiding actions led the participant to find such conceptual links (particularly causal and sequential) between the elements of text content and text topics that he did not initially consider. Both the headings of the meta-markers and their linked questions evoked the participant's reflections on the meanings of the elements of text content. They also drew his attention to separate linguistic expressions in the texts frequently used to signal the presence of various coherence and conceptual relations between the elements of expository texts and their topics. The regular use of the model in structuring activities exposed the participant to some widely used linguistic expressions (for instance "refer to", "bring a thing about") that he did not spontaneously associate with the coherence relations that they are used to represent. On the basis of these findings, it can be concluded that the use of the meta-model, first of all, mediated the generation of the global structure (macrostructure) of the texts being processed during the interventional sessions. However, the (intervener's) explication of the meanings of some linguistic expressions during the participant's use of the model also exerted influence on how the participant processed more local structures of these texts.

The participant started spontaneously to use the conceptual model in structuring text content while reading during the interventional sessions. This initiative can be regarded as indicating a first slight step in the relocation of scaffolding agency from the intervener to the participant in text structuring activities. Subsequently, the participant started to use some elements of the model in structuring text content in his overt speech. He also explicitly attributed a function of thinking that facilitates reading to these activities. In addition to spontaneously using the conceptual elements of the model in text structuring, the participant, a number of times, made self-initiated attempts to recall and check how the separate expressions in the model were linked to its meta-markers. In these attempts, he

addressed some linguistic markers that he had not been able, previously, to associate with the definitional and causal information that they signal.

As the present study focused on the explorative use and testing of an external scaffolding tool in an individual intervention, the findings should be interpreted with caution. The guiding activities used in the study do not represent an interventional prototype of a procedure that can be straightforwardly applied in assisting blind learners' reading activities in similar cases. However, the results argue for the relevance of the systematic modelling of coherence and conceptual relations as well as their linguistic expressions in guiding blind persons to structure and reflect on text content while reading. A digital conceptual model used with this purpose for a blind learner's reading activities can perform a similar function as pre-structured knowledge maps used with sighted readers. The model, based on the frequent coherence and conceptual relations used to organize content in expository texts, can be used as an orientation basis in an intervention, firstly, to evaluate how a reader makes sense of these relations and their representation by linguistic markers. Secondly, an intervener can tailor the use of the model in his or her guiding activities to address, particularly, those relations and linguistic markers that the reader is prone to ignore or misunderstand.

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