GUIDING A BLIND READER’S STRATEGIC QUESTIONING IN PROCESSING EXPOSITORY TEXTS

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Abstract

Reading comprehension is a multifaceted cognitive skill, which has been found to be closely related to a reader's general world knowledge. Consequently, in our opinion, understanding complexly structured expository texts poses a particular challenge to a learner whose access to world knowledge is limited due to the impairment of perceptual or cognitive functions. The main purpose of this study was to develop and explore an auxiliary orienting tool that facilitates a young blind reader’s predictive question asking and other activities, these activities being known to contribute to reading comprehension in the processing of expository texts. The reported case-study provides evidence that that the intervention, based on the use of an external orienting tool, markedly widened the scope of questions posed by the participant about the topics of the texts read. The methodological foundations of the interventional approach derive from Piotr Galperin’s Theory of planned stage-by-stage formation of mental actions and concepts. Our approach, however, also capitalizes on other interventional practices which have been found to elicit reading comprehension, as reported in various studies over the past three decades.

Introduction

Blind readers’ comprehension of texts, until the 1990s, was not an object of particular concern in scientific studies (Carreiras & Alvarez, 1999; Gonzalez Garcia, 2002, 2004). Studies conducted in that period and after have shed light on the correlation between blind people’s reading comprehension performance and their predominant

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reading technique (Braille and others) (Carreiras & Alvarez, 1999). These studies, concurring with Gonzalez Garcia (2004), suggest that an important research objective for the future will be to address the following questions: how do blind readers’ text comprehension processes depend on access channels to world knowledge? How do the evolutionary patterns of these processes compare to the ones of sighted readers? A relevant concern, when particularly considering those readers who are blind from the birth, is the issue of how the lack of visual access to general world knowledge should be taken into account when scaffolding their reading activities. This paper summarizes the results of an explorative case study addressing this problem.

In what follows, various conceptual frameworks and interventional approaches related to the use of questioning in supporting readers’ text processing are briefly summarized. Secondly, we introduce the central structure of the so-called theory of planned stage-by-stage formation of mental actions and concepts created by Piotr Galperin, a prominent representative of activity theory. Finally, we report the findings of a case study applying Galperin’s approach to the shaping of a young blind reader’s strategic questioning.

The role of questioning in processing expository texts

Reading comprehension studies over the past decades have revealed the significant influence of world knowledge on the comprehension of expository texts (Anderson & Pearson, 1984; Cook & Guéraud, 2005; McNamara, Kintch, Songer, & Kintch, 1996; McNamara, 2001; Moravcsik & Kintch, 1993). These findings have led teachers and instructional designers to develop methods to activate and expand readers’ relevant world knowledge in their reading process and promote enhanced means of acquiring such knowledge.

Students can be taught to generate questions which apply information from a text to novel situations and thus to expand their world knowledge in the reading process (Palincsar, 2003). Reciprocal teaching (RT), for example, widely practised since the 1980’s, has used questioning as one of its basic strategic tools, one taught to students during dialogically focused classes (Brown & Palincsar, 1989; Palincsar & Brown, 1984; Lederer, 2000). RT emphasizes the integration of question generation practices into educational settings designed to foster strategic questioning in conjunction with other strategies, such as summarizing, clarifying and predicting, found to play a pivotal role in reading comprehension.

Elaborative questions have been proven to orient readers to their prior knowledge and to help explain the facts encountered in texts (Chi, De Leeuw, Chiu, & LaVancher, 1994; Graesser, McNamara, & VanLehn, 2005; King, 1992; 1994; Martin & Pressley, 1991; Pressley et al., 1992; Pressley 2000). The Elaborative Interrogation approach (EI), similarly, places emphasis on the manipulation of students’ knowledge construction by means of self-generated or inserted questions, prompting them to make connections with prior knowledge (Dornisch & Sperling, 2006; Ozguner & Guthrie, 2004; Woloshyn, Wood, Willoughby, 1994). Inserted ‘why’ questions, as a key ele-
ment of EI–interventions, have been found to facilitate the memorization of texts, formation of coherent mental representations as well as learners’ inferential processing of the text content (Dornisch & Sperling, 2006; Ozgungor & Guthrie, 2004; Seifert 1993). Why-questions, however, have been proven to be significantly more beneficial for students with high prior knowledge (and average and high achievers generally) than for less advanced learners (Woloshyn, Wood, Willoughby, 1994; Wood, Willoughby, Bolger, Younger, & Kasper, 1992). An instructor’s guidance, which enhances readers’ self-explanations, in turn, has been found to be more helpful than elaborative interrogation for undergraduate university students with low prior domain knowledge in processing academic materials (O’Reilly, Symons, & MacLatchy-Gaudet, 1998).

The Selection, Organization and Integration (SOI) model, introduced by Mayer (1996), which shows a close adherence to individualistic constructionism, highlights the role of elaborative questions in integrating the material being read. It proposes that assisting adjunctive questions, inserted in an educational texts or posed by a teacher, facilitate the selection of relevant information in the target material. In support of this proposal, it has been recently demonstrated that undergraduate students with relatively low skills in focusing on essential information from texts, appear to benefit more from encounter with adjunctive questions helping them to create a mental representation of the text than from exposure to elaborative why-questions (Callender & McDaniel, 2007).

In a study of reading and writing skills, Bereiter and Scardamalia (1987) proposed that, rather than asking readers questions related to text processing, teachers should model the process of asking questions of the text or of oneself, then coach readers to carry out the modelled process. Beyond investigations into reading comprehension and writing, the process of question generation has been one of the focuses of knowledge-building pedagogy. It engages learners in studying various curricular topics by having them pursue their own questions, student-generated intuitive theories, and searching for new information (Hakkarainen, 2003; 2004; Scardamalia, 2002).

Various modelling endeavours have addressed question-asking in processing expository texts in order to capture its fundamental mechanisms. The so-called PREG–model postulated by Otero and Graesser (2001) offers discriminating predictions about the particular questions readers ask when seeking to understand texts. The authors regard the explicit text, the reader’s world knowledge, meta-cognitive skills and knowledge of pragmatics of communication as key factors affecting question generation processes and suggest that explicit texts as well as knowledge structure can be represented as conceptual graph structures. According to the PREG-model, these structures consist of a set of statement nodes, which refer to different kinds of ontological categories (concept, event, state, goal) and are linked by relational arcs (e.g. is an instance of, contain, cause, enable, reason).

The proposition that organized knowledge can be well represented in graph structures has been applied during the past 15 years in promising intervention studies that sought to design various kind of knowledge maps (KM) for facilitating reading comprehension and recall of learned information (Chmielewski & Dansereau 1998; O’Donell, Dansereau, & Hall, 2002). These studies have demonstrated that the use of invariant external markers, ones referring to various dependent and conceptual rela-
tions, remarkably enhances the processing of the information represented by expository texts. Knowledge maps, however, have so far not been used as instructional artefacts to facilitate question generation. Elaborative questions reflecting similar dependent and conceptual relations to those in knowledge maps have been reported to enhance self-explanations promoting deeper understanding of expository materials (Chi, De Leeuw, Chiu, & LaVancher, 1994).

In order to generate questions about a given phenomenon from a wide set of perspectives, a learner should possess a relatively well-developed understanding of the potential ontological categories and relations that play a central role for the phenomenon in question. This can be seen to pose a particular challenge to a blind reader, who not only lacks visually mediated knowledge about these categories and relations, but may be lacking in textually mediated knowledge as well. If we see questioning as one of the key processes in reading comprehension, the issue becomes one of how to guides blind learners to generate useful adjunctive questions that would help them to focus on essential text content and enhance their explanations to themselves.

**Question generation as orienting activity in reading for understanding**

In the present interventional study, the participant's question generation was considered and fostered as a form of orientation activity, performing a regulative function in processing expository texts. According to Piotr Galperin (2002; Arievitch & van der Veer, 2004), mental, image-based orientation activity entails presenting the field of possible actions in the environment to the individual, the evaluation of the functional significance of certain elements of that field, planning appropriate action and monitoring the performed action.

To capture those mechanisms which enable mental activity to emerge from the external events involving the learner, Galperin (1965; 1969; 1992; 2002; Liders & Frolov, 1991; Podolskij, 1997; 2002) created the so-called *theory of planned stage-by-stage formation of mental actions and concepts*. The theoretical and methodological underpinnings of the Galperinian formation theory go back to the central assumption made by the representatives of cultural-historical theory, namely that children's cognitive functions are quite malleable before their spontaneous emergence in normal development (Leontiev, 1981; Talyzina, 1983; Vygotski, 1983; Zhaporozhets & Elkonin, 1983). Given the elaborate structure and practical applicability of Galperin's views on education and learning processes, his approach, in our opinion, has played a pivotal role in the continuation and elaboration of the theoretical, developmental approach founded by Vygotsky.

The theory of planned stage-by-stage formation of mental actions and concepts (PSFMAC theory, in what follows) outlines the conditions which enable the emergence of new intelligent operations in an external form and allow their further internalisation. Galperin divided these conditions into four subsystems, which he held to be the basic ones involved in the formation of mental actions. The *first subsystem*
comprises conditions eliciting the learner’s motivation in a learning process. The second subsystem is related to the conditions necessary for the building of required action or the formation of its orienting basis. The main function of conditions belonging to the third subsystem of the PSF-MAC theory is to refine, through practice, the desired key properties of the target action of the intervention. The fourth subsystem of the step-wise formation of mental actions refers to those conditions which support consecutive transformations of the intermediate materialized and verbal forms of an action into an internal mental plan. The PSF-MAC approach has not so far been applied in reading comprehension studies. However, we propose that it can provide a worthwhile methodological framework for integrating the previously developed efficient methods of various reading comprehension intervention. Furthermore, this approach may widen the methodological perspective in order to deal with the particular challenges faced by these interventions.

One of the cornerstones of Galperin’s theory of learning, the concept of “orienting basis”, refers to a system of modelling instructions which are needed to shape the required action at a desired level of proficiency. The orienting basis implies that there is an evolution of a generalized representation of the problem situation and the adaptive forms of activity related to it. It guides a learner’s activity in the process of acquiring new knowledge and skills. An orienting basis may have a pre-structured form, but it will be modified and elaborated in the formation process. In its widest form, it not only defines necessary properties of action to be formed, but also involves a model of the essential structures and internal connections of the object being acquired or dealt with during a learning process. It is thus intended to facilitate a deep analysis of the elementary units of the target object as well as their interrelations.

The pedagogical solutions based on the implementation of various forms of orienting bases range from interventions related to the teaching of basic mathematical and linguistic skills (Amano, 1999; Galperin, 1992; Oboukhova, Porshnev, Porshneva, & Gaponova, 2002) to educational settings aiming to shape students’ analytical skills in higher education (Reshetova, 2004). Thus, for instance, Porshnev (Oboukhova et al., 2002) has developed a particular form of electronic orienting card serving as an instructional component in the software designed for teaching French. This component represents to learners the specific grammatical information needed in forming various sentences that apply French verbs in the past tense. Reshetova (2004) and her colleagues have implemented learning charts guiding students in higher education to analyze various objects related to their training programs by means of the generic categories of systems analysis and the concepts of specific sciences. The categorical apparatus of the systemic approach (including, for instance, such categories as “environment,” “structural elements,” and “levels”) as well as the analytic procedures to be acquired are modelled in these orienting schemas and used in guiding students to analyze various objects related to their learning tasks. In similar vein, subjects involved in the students’ training programs are introduced to them as systems by means of this categorical apparatus.

When used to facilitate text processing, the second subsystem of the PSFMAC theory appears to imply that, in addition to explaining adaptive reading strategies, texts should somehow also be explained via scaffolded text processing. Like Graesser, McNamara and Louwerse (2003), we also assume that the various types of coherence
relations used to organize text content into meaningful units deserve to be particularly addressed in this respect. Moreover, we argue that, by virtue of reflecting frequent coherence relations in typical expository texts, the PRÉG model as well as the KM approach are potentially useful conceptual frameworks for the development of systematic object-centred practices in scaffolding question generation.

According to Galperin (1965; 1969; 1992; 2002), the successful application of the third subsystem of PSFMAC-theory in formation interventions requires a wide selection of educational materials to which the learner is exposed in the intervention process. The aim here is to guide the learner to distinguish conceptual features of objects or problem situations from surface-level appearances, to discriminate the necessary parameters from superficial ones and, finally, to introduce the learner to a wide variety of possible objects, contents, and activities. Thus, for instance, the software developed by Porshnev for teaching French is endowed with a large selection of tasks covering the most important variations of contexts in which grammatical constructions being learned can be applied.

Experience with the implementation of the third subsystem of the PSFMAC-theory in scaffolding text processing suggests that a learner should be exposed, in a systematic way, to the multiplicity of various, typical textual sources requiring him or her to distinguish the essential body of knowledge from less crucial contents. In line with this interpretation, Graesser, McNamara and Louworse (2003) have argued for the systematic exposure of learners to various coherence relations in texts.

Outlining the conditions supporting internalization, the fourth subsystem of the PSFMAC-theory suggests an approach, according to which the target action should be shaped in a completely external and materialized form at the beginning of a formation intervention. Incrementally, the external support of action is replaced by representation in overt speech. Simultaneously, the external, materialized support is gradually decreased. Finally, verbalizations become internalized and external actions become transformed as internal forms of thought about actions. In the training being conducted with the educational software designed by Porshnev, the guiding elements of the electronic orienting cards are gradually diminished. At the same time, learners are guided to speak out the operations needed in forming correct grammatical constructions and previously presented in the orienting cards while they complete tasks. During the final phase of this internalization procedure, learners produce the grammatical constructions required in the tasks without needing to explicate such operations verbally. Applied to the design of reading comprehension interventions, the fourth subsystem of the PSFMAC-theory can be interpreted to imply that the strategies contributing to efficient text processing should be externally modelled with learners in a way which facilitates their internalization.

In their studies and writings, Galperin and his collaborators conducted a thorough analysis of the structure of instructional practises, in particular those which assist learners in detecting crucial elements of a problem situation or the object of their activity. The argument for a wide orienting basis implies that learners should be allowed to detect, sort, structure, and even generate key properties of problem situations by means of different kinds of cognitive markers. The use of these sign-tools also enhances the external organisation of learners' activity, their control over it, and the formation of its
desired properties. In this sense, instructional practices included in the PSFMAC approach can be seen to converge with the procedural facilitation strategy [PFS] introduced by Scardamalia and Bereiter (1985a, 1985b), relying on explicit models of the control structures to be acquired. The former [PSFMAC], compared to the latter [PFS], however, appears to place more emphasis on the modelling of the object of learner’s activity, a possible problem situation. To put it in the terms introduced by Valsiner (2007), a wide orienting basis can be seen as an external semiotic mediating device, designed by an educator and setting up the range of possible meaning boundaries for a learner’s future experiences with specific problem situations.

The subsystem model at the heart of the PSFMAC approach helps us to consider how learners may be guided by the systematic use of various reading comprehension strategies. Thus, to scaffold question generation in attempts to enhance reading comprehension can be viewed as a pedagogical intervention requiring the presence of all four subsystems which will gradually allow learners to perform independently. Applied to pedagogical design aimed to foster learners’ questioning when processing expository texts, the first subsystem of the PSFMAC can be seen to imply that interventions should involve various motivating elements, for instance, topics and materials closely related to a participant’s own interests. Experienced specialized teachers and psychologists working with children with learning difficulties often intuitively address this challenge in their remedial practices.

The second subsystem implies both the act- and object-sensitive modelling of a target skill. As one of the key elements in learning to improve reading comprehension, questioning has been elaborately addressed in the Reciprocal Teaching approach and in EL-interventions. However, an orienting basis, regulating questioning in its widest form, should, besides the structure of activity, also reflect its object. The realization of this function requires modelling of an object of questioning.

In the explorative case study reported below, we sought to examine in general how the subsystems of the PSFMAC, particularly the second and third subsystems, could be integratively implemented in scaffolding a blind reader’s questioning activities when processing expository texts.

**Research aims**

The present case study was a part of an individual intervention, the objective of which was to foster the development of a young blind learner’s reading comprehension strategies. The first of the main objectives was to test our orienting basis developed in a prior interventional case study with the view to enhancing a blind reader’s question generation before reading expository texts (Kosonen & Hakkarainen, 2007). Our second aim was to develop this orienting basis to make it more suitable for the participant’s daily learning environment.

The results of the previous study suggested that the use of a conceptual metamodel representing various frequent coherence and conceptual relations of expository texts may be linked with significant gains in a blind learner’s text-processing when reading. Of particular interest, in the light of these findings, is whether the use of a
generic conceptual meta-model in an interactive learning intervention can shape blind readers' questioning strategies in a way that improves their ability to identify frequent coherent relations in texts. The present study addressed these aims through the following specific research questions:

1. How can a conceptual meta-model be implemented as an orienting basis to mediate guiding interactions between the interventee and intervener during the scaffolding of strategic question generation?
2. How does this kind of orienting basis enhance how a participant strategically generates questions when processing expository texts?
3. What kind of guiding elements should be included in the orienting basis to optimise it for scaffolding how questions are generated by the participant when processing expository texts?

**Method**

**Participant: Toni**

Toni was a 17-year-old blind young man, born prematurely in the 26th week of the pregnancy, and whose blindness was caused by an error in the post-natal oxygen treatment.

Toni had finished comprehensive school. At the beginning of the intervention he was attending a special institute for handicapped learners. Toni attended the daily preparatory educational program, which included classes aimed at teaching various practical skills required for independent life.

Toni's executive skills were weak. He had problems concentrating on a single issue or theme in discussions and was prone to be attracted by multiple matters only vaguely related to the main topic.

Toni had been assessed by a psychologist at the age of 13. He was found to have an average IQ and an above average vocabulary score in the WISC-III (Wechsler Intelligence Scale for Children). However, he had had problems with the subtests which required practical understanding and the flexible use of general knowledge. These subtests brought down his Performance score. Toni had also faced significant difficulties in understanding the texts read aloud to him as well as in capturing logical relations between separate facts in the written material. On the basis of the results, the psychologist concluded that Toni's learning problems were probably caused by developmental, neurologically based, moderate dysphasic and attention deficit disorders.

Toni was, to some extent, able to reflect on his problems and was aware of his inclination to speak out everything that came to his mind. He also had problems with reading comprehension and processing the expository texts related to the higher grades in comprehensive school.

Toni was particularly keen to receive help to alleviate his problems. His curiosity along with a wish to improve his general knowledge ensured his sustained stable learn-
ing motivation. He was, however, also aware of his strong points, which helped him to maintain and reinforce his self-esteem.

**Research design and procedure**

The present case study consisted of 20 intervention sessions during which various expository texts were processed with the participant. The study was divided into two stages that differed with regard to the focus of the research and the intensity of the data-collection. The first stage of the study consisted of the time period during which nine sessions were held. The initial version of the orienting basis was implemented and modified throughout this stage by revising its guiding elements and integrating into it new elements that turned out to be useful during the sessions. During the first stage, an intensive data collection about interactive patterns between the intervener and participant as well as about participant’s verbalisations was conducted. The purpose of this data collection was to examine, first and foremost, how the orienting basis would mediate scaffolding provided by the intervener in the process of question generation. Our second aim was to examine how the orienting basis helps the participant to generate questions related to the topics of various expository texts and other phenomena.

The second stage of the study consisted of the time period over which the rest of the eleven sessions of the intervention were held. The sessions focused on the usage of the modified orienting basis in reflecting on the contents of new expository texts. The data collection at this stage, besides the interactive patterns, particularly addressed the development of the participant’s questions and further modifications of the orienting basis.

**Orienting basis used in the intervention**

The orienting basis tested in the present study is partially based on Fillmore’s (1968) theory of semantic roles, the theory of lexical functions introduced by Melcuk (1974), the so-called PREG model, reflecting human question asking (Otero and Graesser 2001) and instructional constructions designed in knowledge map studies in the past 15 years (Dansereau & Chmielewski, 1998). The orienting basis involved the following meta-markers, which reflect a number of central ontological categories and relations of the world as well as the corresponding semantic constructions used to organize ideas into meaningful units in expository texts:

I. Definition of the phenomenon
II. Causes related to the phenomenon
III. Tasks (purposes) related to the phenomenon
IV. Activities/functioning of the phenomenon
V. Examples about the phenomenon
VI. Properties of the phenomenon
VII. Parts, structure of the phenomenon
VIII. Consequences of the phenomenon
IX. Forms of occurrence of the phenomenon
X. Phases, related to the phenomenon (regular)
XI. Events related to the phenomenon (past events)
XII. Location of the phenomenon.

Data collection

All of the 20 intervention sessions, each lasting 45 – 60 minutes, were videotaped and transcribed. The data analyzed in the study consisted of the video-recordings of all sessions, all the drafted versions of the orienting basis and revisions made to them, related intervener’s reflective statements, transcribed guiding interactive episodes between the intervener and the participant, participant’s questions as well as his reflections and other verbalisations. The discussions were held in Finnish, therefore all excerpts of the discussions presented in this article are translations (by a multilingual high-school graduate).

Data analysis

Analysis of the guiding interactive episodes

The analysis of the guiding interactive episodes between the intervener and interventionee focused on the interactive episodes that were somehow mediated by the orienting basis. The analysis, in which both qualitative and quantitative methods were implemented, was intended to shed light on how the orienting basis mediated the intervener’s various scaffolding activities. The episodes which did not serve a guiding function (for example, shared activities related to unforeseen interruptions or to the adjustment of technical tools) were excluded from the data analysis.

Classification of episodes supporting question generation

On the basis of the research questions, interventional objectives and preliminary analysis of the data, the following eleven discrete classes of interactive patterns between the intervener and interventionee were created to serve this purpose. These classes embrace the great majority of the episodes that took place during the sessions.

A. Clarification of the model
   Outset: The intervener begins by describing the whole set of meta-markers to the participant in order to clarify their functions.
   End: The intervener completes his explanation.

B. Question generation without assistance (immediately preceding the use of the meta-markers)
   Outset: The intervener asks the participant to generate questions or asks him to continue question generation with regard to a given topic.
End: The participant comes up with one or several questions or states that he can not generate any questions at that moment.

C. Exposure to a meta-marker
   Outset: The intervener asks the participant to read the guiding conceptualisation of a meta-marker.
   End: The participant reads the textual content of a meta-marker.

D. Clarifying the meaning of a meta-marker
   Outset: The intervener verbally clarifies the meaning of a meta-marker or else demonstrates its meaning by means of material objects.
   End: The intervener concludes such clarification or the discussion arising from such clarification ends.

E. Linking verbalisation
   Outset: By means of some meta-marker, the intervener discusses the participant’s spontaneous considerations related to some phenomenon concerned.
   End: The intervener concludes his reflective talk or the discussion closes.

F. Generating questions by means of an auxiliary questioning expression
   Outset: The intervener pronounces an auxiliary word or expression and asks the participant to generate a question using it.
   End: The participant comes up with one or several questions.
   The auxiliary questioning expressions were “what”, “why” “how”, “when”, “where”, “what is it like” and “What consequences does it have?”

G. Generating questions by means of a meta-marker
   Outset: The intervener asks the participant to generate questions with regard to a given topic on the basis of the textual content of a meta-marker.
   End: The participant comes up with one or several questions.

H. Generating questions by means of a meta-marker recalled by the participant
   Outset: The intervener asks the participant to generate a question based on the recalled meta-marker.
   End: The participant comes up with one or several questions.

I. Generating questions by means of a meta-marker and with intervener’s assistance
   Outset: The intervener makes an attempt to help the participant to generate a question by means of a meta-marker after the participant has tried to do so on his own.
   End: The question is generated or the intervener initiates the following type of interactive episode.

J. The intervener poses a question related to some meta-marker.
   Description: The intervener generates a question by means of some meta-marker after the participant has tried to do so.

K. Linking questions
   Outset: The intervener asks the participant to think about which of the meta-markers his question can be related to.
   End: The participant’s response to the intervener’s request is completed with the intervener’s assistance.

Classifying episodes involving text processing
In addition to those interactive episodes directly related to the use of meta-mark-
ers, the following types of interactive episodes involving text processing were proposed on the basis of the collected data:

L. **Exposing the participant to a textual source**
   Outset: The intervener reads the participant a sentence or a group of sentences constituting a textual source.

M. **Finding topic**
   Outset: The intervener asks the participant to try to summarize the text.
   End: The topic, identified either independently by the participant or with intervener’s assistance, is accepted by the latter.

N. **Clarifying a word or expression**
   Outset: The participant asks the intervener about the meaning of a word or expression or the intervener realizes in some other way that the participant needs clarification.
   End: The intervener explains the meaning of a word or expression.

O. **Linking a textual source**
   Outset: The intervener asks the participant to think about which of the questions generated previously or which of the meta-markers the content of the textual source can be related to. The intervener asks the participant to think about how questions can be answered or asks him to summarize the content related to the meta-marker involved.
   End: The participant generates an answer or summary according to the intervener’s request or the intervener helps him to answer related questions.

P. **Elaborating an answer**
   Outset: The intervener helps the participant to answer a particular question after the latter has tried on his own on, either aided by textual indices or on the strength of his own reflections.
   End: Answering the question is concluded.

**Detailed analysis of episodes addressing the clarification of meta-markers and linking textual sources.**

An additional content analysis of the guiding episodes scored into the class D (Clarifying the meaning of a meta-marker) was conducted to systematically trace the guiding actions and elements used by the intervener in clarifying the meanings of separate meta-markers. The main objective of this analysis was to find those compact conceptualisations which helped the participant to understand the meaning of various meta-markers and which, therefore, could be embedded into future versions of the orienting basis.

Another additional analysis was directed to the sessions during which the contents of various textual sources were reflected by means of the meta-markers or the meaning of separate meta-markers were clarified (class O: Linking a textual source). This analysis was done only for the sessions in the second stage (11-20). The linking episodes mediated by the orienting basis were divided into categories corresponding to the meanings of the separate meta-markers. This classification procedure aimed to help us analyze the influence of the mediated linking episodes taking place during separate
sessions on the number and content of the questions that the participant generated in the subsequent sessions.

**Analysis of the participant's questions and other verbalisations**

The content of the participant's questions were analyzed in order to trace the influence of the guiding interactive episodes and the use of orienting basis on question generation. We focused here on three areas. One area focused on whether the participant's questions were open-ended questions, i.e., requiring responses other than “yes” or “no”. A second area involved verification questions inviting only short “yes/no” answers. The final area involved an analysis of the character of information sought in the questions (for instance feature specification, definition, goal orientation, causal antecedent). The conceptual framework used in the analysis converges with the 18 question-content categories of the analytical schema called GPH, introduced by Graesser, Pearsson, and Huber (1992).

The participant's answers to the intervener's questions about the correspondence between the meanings of the meta-markers and the text-contents served as raw data for the analysis of how the participant used the orienting basis to represent the semantic constituents of the texts being processed during these second stage intervention sessions.

Guiding interactive episodes and the participant's performance were not only analyzed sequentially, but also qualitatively and quantitatively. The purpose of these interpretative meta-analyses was to examine the interrelations of a number of items. Firstly, the intervener's use of meta-markers in reflecting various textual contents. Secondly, the participant's progress in capturing essential semantic relations in text. The final item analyzed concerned the development of the content of his questions. The meta-analysis was conducted by tracing changes or progress in the participant's performance as well as in the activities preceding them and by interpreting the influence of these activities on the participant's progress.

**Independent evaluation of the generated questions**

The set of questions generated by the participant during the intervention were analyzed according to two criteria, **analyticity and predictivity**, by a group of 47 undergraduate students as outside evaluators and thus unfamiliar with the intervention and intervener-driven analysis. These independent evaluators were exposed to the data, consisting of sets of questions generated by the participant with regard to four separate, randomly organized topics in a text file. Two sets of questions were generated at the outset of the intervention (1. and 3. session) and the rest during two of the last sessions.

According to the instructions, **analyticity** refers to the extent to which the set of questions helps one to consider the topic's various dimensions. **Predictivity**, in turn, was defined as the perceived probability that a reader can find answers to the questions of a set being evaluated in widely publicly available informational texts on the topics concerned. The evaluators scored each set of questions with regard to the two
defined criteria by using a scale consisting of four points, each having a separate meaning (1=poor; 2=passing; 3=satisfactory; 4=good). The assessments with regard to the analyticity as well as the predictivity of the set of questions were compared by means of paired t-tests with the SPSS program.

Results

Overview of the intervention process and activities

In the intervention, the subject’s exposure to meta-markers of the orienting basis was accompanied by concrete instructions regarding basic strategic procedures known to facilitate reading comprehension. The participant in our study was acquainted in the first sessions of the intervention with the set of meta-markers. Each meta-marker was illustrated by providing the subject with examples of questions and statements, corresponding to the semantic content of a single marker. The initial version of the orienting basis was drafted in the form of a clock-board-like external schema, because blind children and youngster are usually guided spatially by means of the coordinates of the clock-board.

Below, Tables 1 and 2 summarize the content of the sessions at stage 1 (sessions 1-9) and at stage 2 (sessions 11-20) with regard to their objectives, topics, and related activities. Among the topics concerned, “Media-coaching as a school subject” and “Children’s temper tantrums” were particularly closely related to the participant’s current interests. The participant spontaneously started to read a text on the latter topic during the studied interventional process. In what follows, the findings related to the sessions are presented in detail.

During the first nine intervention sessions, the participant was repeatedly exposed to various expository texts and asked to generate questions about their theme, initially without assistance, and then by means of externally displayed meta-markers. He was also asked to think which markers could be easily and appropriately used in relation to the theme in question. The purpose of this elaboration of the model was to shape the learner’s analytical abilities and to thereby facilitate how he learnt to use meta-markers as tools of thinking. During the question generation activities, the meanings of the meta-markers were also clarified and elaborated. These elaborative activities led the intervener to modify the orienting basis in order to make it more comprehensible to the participant.

After the first nine sessions, the intervener revised the initial version of the orienting basis together with the participant. A new meta-marker, “XIII. How can the knowledge about the phenomone be acquired?”, typed on a paper-slip, was added to the initial clock-board schema. The findings related to the revisions and the other details of these revisions are represented in the sections 3.2. and 3.3.. During the sessions 11 – 20 (Table 2) the focus of interventional activities shifted from the systematic generation of questions to the reading of various expository text fragments and reflections on their content by means of the meta-markers.
Table 1. Overview of the intervention sessions 1-9.

<table>
<thead>
<tr>
<th>Date</th>
<th>Topics and themes</th>
<th>Main objectives</th>
<th>Main activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 22.5.05</td>
<td>Personal matters, Circulation of computers</td>
<td>Launching an initial rapport and working alliance, introduction to the orienting basis and working procedures</td>
<td>Discussing personal matters by using clockboard model as a mediator, generating questions with regard to the circulation of computers</td>
</tr>
<tr>
<td>2. 5.6.05</td>
<td>The stairs of the city of Odessa as a historical venue</td>
<td>Introducing the orienting basis, assessing its usability</td>
<td>Generating questions with regard to the topic, reading, juxtaposition of the text content with the questions and the orienting meta-markers</td>
</tr>
<tr>
<td>3. 12.6.05</td>
<td>Media-coaching as a school subject</td>
<td>Rehearsing the use of orienting basis, assessment of its usability, rehearsing focused reading and summarizing</td>
<td>Generating questions, reading, finding answers</td>
</tr>
<tr>
<td>4. 7.9.05</td>
<td>Hurricane Katrina</td>
<td>The same as above</td>
<td>The same as above</td>
</tr>
<tr>
<td>5. 14.9.05</td>
<td>Beach-ball (a material object) Hurricane Katrina</td>
<td>Clarifying the meaning of the semantic meta-markers, rehearsing focused reading and summarizing</td>
<td>Analysing the beach-ball by means of orienting basis, reading, finding answers to questions regarding hurricane Katrina</td>
</tr>
<tr>
<td>6. 21.9.05</td>
<td>Umbrella (as a material object and the topic of a text) Hurricane Katrina</td>
<td>The same as above</td>
<td>Generating questions with regard to an umbrella, reading, finding answers, analysing the material object by means of the orienting basis, finding answers to questions regarding the hurricane Katrina</td>
</tr>
<tr>
<td>7. 29.9.05</td>
<td>Meaningful learning</td>
<td>Rehearsing the use of the orienting basis</td>
<td>Generating questions</td>
</tr>
<tr>
<td>8. 5.10.05</td>
<td>Meaningful learning</td>
<td>Rehearsing inquiry strategies (generating self-explanations, summarizing</td>
<td>Generating answers, reading, finding answers in textual sources, writing a summary</td>
</tr>
<tr>
<td>9. 21.10.05</td>
<td>Municipal home services in the city of Helsinki, Hurricane Katrina</td>
<td>Rehearsing the use of the orienting basis, evaluating its usability, rehearsing focused reading and summarizing</td>
<td>Generating questions with regard to the fit with the topic, reading, finding answers to the questions regarding the second topic</td>
</tr>
<tr>
<td>Date</td>
<td>Topics and themes</td>
<td>Main objectives</td>
<td>Main activities</td>
</tr>
<tr>
<td>---------</td>
<td>-----------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>11. 4.11.05</td>
<td>Carbon monoxide barrel</td>
<td>Assessing the internalization of the orienting basis, rehearsing its use, rehearsing focused reading and summarizing</td>
<td>Generating questions, reading, finding answers</td>
</tr>
<tr>
<td>12. 11.11.05</td>
<td>Children's temper tantrums</td>
<td>Rehearsing the use of orienting basis, questioning, focused reading and summarizing</td>
<td>Same as above</td>
</tr>
<tr>
<td>13. 18.11.05</td>
<td>The same as above</td>
<td>Rehearsing focused reading and summarizing</td>
<td>Reading, finding the answers to the posed questions, generating new questions</td>
</tr>
<tr>
<td>14. 25.11.05</td>
<td>The same as above</td>
<td>Rehearsing summarizing</td>
<td>Writing a summary</td>
</tr>
<tr>
<td>15. 2.12.05</td>
<td>Baby's development</td>
<td>Rehearsing the use of orienting basis, questioning, rehearsing focused reading and summarizing</td>
<td>Generating questions, reading, finding answers</td>
</tr>
<tr>
<td>16. 12.1.06</td>
<td>Municipal homeservices, Metronomes, Chairs, Cats</td>
<td>Reinforcing the internalization of the orienting basis, rehearsing focused reading and distinguishing essential from unessential content</td>
<td>Recalling meta markers, reading, finding the correspondence between text-fragments and meta-markers</td>
</tr>
<tr>
<td>17. 27.1.06</td>
<td>Making meatballs, Widthband connections in the Internet, Tartar, Dogs breathing, Bicycle, Hector (The famous Finnish pop-artist)</td>
<td>Same as above</td>
<td>Same as above</td>
</tr>
<tr>
<td>18. 11.2.06</td>
<td>Bats, Fears</td>
<td>Same as above</td>
<td>Same as above</td>
</tr>
<tr>
<td>19. 3.3.06</td>
<td>Stress</td>
<td>Assessing the internalization of the orienting basis, rehearsing questioning, focused reading and summarizing, introducing the renewed form of the orienting basis, reinforcing its internalization</td>
<td>Generating questions, reading, finding answers to the posed questions.</td>
</tr>
<tr>
<td>20</td>
<td>Vocational training</td>
<td>Assessing the usability of the third version of the orienting basis</td>
<td>Generating questions on the topic</td>
</tr>
</tbody>
</table>
The orienting basis was revised once more after the 18th session. Among the revisions, one further meta-marker, “XIV. Frequency of appearance of the main phenomenon”, was added to the orienting basis. The other details of the revisions are presented in section 3.3. Toni was acquainted with the modified orienting basis immediately after the text on stress was discussed in the 19th session. For two weeks after this particular session, he spontaneously returned to the renewed orienting basis when using his own computer.

**Nature of the interactive guiding episodes during all intervention sessions**

A total number of 576 interactive episodes, related to the participant’s guidance, rehearsal or reflection during the sessions were scored into the previously created classes. The length of these episodes varied from two to ten minutes, which explains the high variation in the number of the episodes in separate sessions. We see, in Table 3, which presents the total number of guiding episodes, that the episodes during which questions were generated occupied a central position in the first half of the intervention process (episodes categorized as B, F, G, H, I, J, and K) whereas the episodes related to the reflection of textual contents being processed (episodes categorized as L, M, N, O, and P) became more frequent during the second half of the process.

The separate analysis of the episodes entailing clarifications of the meanings of the meta-markers (class D) provided useful data about necessary, additional guiding elements and actions. Clarifications could only be made verbally, by attaching paper-slips with related expressions to the initial version of the orienting basis or by elucidating the meanings of separate meta-markers by exposing the participant to various material objects.

The analysis of class “D” interactive guiding episodes revealed that the meta-markers “Events, related to the phenomenon” (XI), “Phases, related to the phenomenon, “(X) and “Forms of occurrence of the phenomena, (IX)” were concerned most frequently in these clarifications. Thus, for instance, the intervener repeatedly pointed out that the meta-marker “Events related to the phenomenon” refers to various historical events or events in the future, which have taken place or will take place only once, while the meta-marker “Phases, related to the phenomenon” is about the events which take place repeatedly and regularly. Table 4 summarizes the frequency of each meta-marker in class D.

In addition to verbal clarifications of the meta-markers “Parts, structure of the phenomenon”, “Phases related to the phenomenon” and “Types”, the meaning of the concepts “parts”, “types” and “phases” were illustrated via material objects such as a beach ball and an umbrella. For instance, the participant was not only asked to touch various types of umbrellas or the parts of a beach ball, but also taught how the use of an umbrella can be described as including subsequent regular phases (taking the umbrella from a rack or stand, opening it, going out with the umbrella and keeping it above your head).

The expressions added to the initial version of the orienting basis are specified in section 3.3.
The separate analysis of all guiding interactive episodes scored as “linking textual sources” shed light on how many times the discrete meta-markers were used in linking. As can be seen in Table 5, the meta-markers X (Phases, regular), II (Causes) and I (Definition) occupied a central position in the linking of textual sources. Also such meta-markers as IX (Types), III (Purpose), IV (Activity) and XI (Events, past) were used several times, although less frequently. The character of revealed frequencies presumably was related, on the one hand, to the intervener’s priorities in selecting materials and on the other, to certain extent to the actual frequency of corresponding coherence relations inherent in various expository texts.

### Table 3. Interactive episodes

<table>
<thead>
<tr>
<th>Number of session at Stage 1</th>
<th>Number of sessions at Stage 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5 6 7 8 9</td>
<td>11 12 13 14 15 16 17 18 19</td>
</tr>
<tr>
<td>A 10 1 1 1 A</td>
<td>B 3 5 5 3 4 B 3 3 2 3 6</td>
</tr>
<tr>
<td>B 3 5 5 3 4 B 3 3 2 3 6</td>
<td>C 5 12 9 11 12 C</td>
</tr>
<tr>
<td>C 5 12 9 11 12 C</td>
<td>D 8 7 3 5 6 4 D 1 1 1 3 1</td>
</tr>
<tr>
<td>D 8 7 3 5 6 4 D 1 1 1 3 1</td>
<td>E 3 2 1 E</td>
</tr>
<tr>
<td>E 3 2 1 E</td>
<td>F 7 7 7 F 6 7</td>
</tr>
<tr>
<td>F 7 7 7 F 6 7</td>
<td>G 8 5 10 9 6 G 11 1 2 14</td>
</tr>
<tr>
<td>G 8 5 10 9 6 G 11 1 2 14</td>
<td>H 2 2 H 1</td>
</tr>
<tr>
<td>H 2 2 H 1</td>
<td>I 4 1 4 4 2 I 1 1</td>
</tr>
<tr>
<td>I 4 1 4 4 2 I 1 1</td>
<td>J 1 1 1 2 J</td>
</tr>
<tr>
<td>J 1 1 1 2 J</td>
<td>K 4 2 6 2 4 2 1 K 1 1 1 2</td>
</tr>
<tr>
<td>K 4 2 6 2 4 2 1 K 1 1 1 2</td>
<td>L 4 6 2 3 15 1 9 L 13 2 1 3 7 5 8 15 8</td>
</tr>
<tr>
<td>L 4 6 2 3 15 1 9 L 13 2 1 3 7 5 8 15 8</td>
<td>M 1 1 1 2 5 1</td>
</tr>
<tr>
<td>M 1 1 1 2 5 1</td>
<td>N 9 1 2 1 1 1</td>
</tr>
<tr>
<td>N 9 1 2 1 1 1</td>
<td>O 3 5 2 3 9 O 6 3 4 5 5 7 12 17 7</td>
</tr>
<tr>
<td>O 3 5 2 3 9 O 6 3 4 5 5 7 12 17 7</td>
<td>P 1 5 4 1 1 1 1</td>
</tr>
<tr>
<td>P 1 5 4 1 1 1 1 1</td>
<td></td>
</tr>
</tbody>
</table>

Table 4. The frequency of individual meta-markers in guiding episodes

<table>
<thead>
<tr>
<th>Meta-marker</th>
<th>Times used</th>
<th>Meta-marker</th>
<th>Times used</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Definition of the ph</td>
<td>4</td>
<td>VIII Consequences</td>
<td>4</td>
</tr>
<tr>
<td>II. Causes of the ph</td>
<td>2</td>
<td>IX. Forms of occurrence of the ph.</td>
<td>6</td>
</tr>
<tr>
<td>III. Tasks (purpose) of the ph.</td>
<td>3</td>
<td>X. Phases, related to ph. (regular)</td>
<td>11</td>
</tr>
<tr>
<td>IV. Activities/functioning of the ph.</td>
<td>3</td>
<td>XI. Events (past) related to the ph</td>
<td>10</td>
</tr>
<tr>
<td>V. Examples about the phenomenon</td>
<td>12</td>
<td>XII. Location of the ph</td>
<td>0</td>
</tr>
<tr>
<td>VI. Properties of the phenomenon</td>
<td>2</td>
<td>XIII. How can knowledge about the ph be acquired?</td>
<td>0</td>
</tr>
<tr>
<td>VII. Parts, structure of the phenomenon</td>
<td>4</td>
<td>XIV. Frequency of appearance of the main ph.</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 5. The frequency of individual meta-markers in guiding episodes

<table>
<thead>
<tr>
<th>Sessions/met-m.</th>
<th>S11</th>
<th>S12</th>
<th>S13</th>
<th>S14</th>
<th>S15</th>
<th>S16</th>
<th>S17</th>
<th>S18</th>
<th>S19</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>III</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VII</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VIII</td>
<td></td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IX</td>
<td>2</td>
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<td>2</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
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<td>2</td>
<td>4</td>
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<td></td>
<td></td>
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<tr>
<td>XI</td>
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<td>1</td>
<td>4</td>
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<tr>
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<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XIII</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

I. Definition II. Causes, III. Tasks (purpose), IV. Activities, V. Examples, VI. Properties of the phenomenon, VII. Parts, structure, VIII. Consequences IX. Forms of occurrence, X. Phases (regular), XI. Events (past), XII. Location, XIII. How can knowledge about the Red string be acquired? (Added later in the interventional process, see the next section)
Revisions of the orienting basis

The first slight revisions of the orienting basis were made during class D interactive guiding (clarifying the meaning of a meta-marker) in the sessions 1-9. Revisions regarded those meta-markers, the meanings of which the participant did not sufficiently understand.

During Class D episodes, the following expressions were typed on paper-slips and attached to the meta-markers of the clock-board-like external schema used as an initial version of the orienting basis:

- Definition of the phenomenon; the word “What?” was added.
- Tasks (purposes) of the phenomenon; the word “Purpose” was added.
- Properties of the phenomenon; the expression: “What is it like?” was added.
- Consequences of the phenomenon; the words “Benefits and disadvantages” were added.

- Forms of occurrence of the phenomenon: The word “Types” was added.

During the 10th intervention session, the intervener reconstructed the orienting basis with the participant into the form of paper sheets on which the participant, with the aid of a Braille typewriter, typed the revised definitions and descriptions of the meta-markers. The reformulations made with regard to the separate meta-markers were negotiated with the participant in order to find the conceptualisations which optimally conveyed their meaning to him.

Most of the changes regarded the meta-markers that turned out to be poorly comprehended during the first half of the interventional process. A detailed overview of these comprehension problems is presented in section 3.4. In addition to the reformulations, a new meta-marker was added to the initial set. This meta-marker refers to an issue, frequently appearing in various expository texts, the means of acquiring and constructing knowledge about the phenomenon concerned in them. After revisions, the orienting basis comprised the following 13 meta-markers.

I. Definition; What?
II. Causes; Things causing the Red string* and affecting it
III. Purpose of the phenomenon
IV. Activity; What does the phenomenon do?
V. Examples
VI. Properties; What is the phenomenon like?
VII. Parts, Structure; What does the phenomenon consist of?
VIII. Consequences of
IX. Forms of the phenomenon Types
X. Repeating phases of existence or development
XI. Historical phases; When?
XII. Location
XIII. How can the knowledge about the Red string be acquired?

* The expression “Red string” in Finnish generally refers to the topic or main point of a discussion or message. The participant used it regularly when speaking about the topics that arose during the sessions.
The purpose of last revisions of the orienting basis was to reduce the burden of its numerous elements on the participant's working memory and also provide scaffolds that would help him to apply the meta-markers particularly to questioning. The last modification of the orienting basis took place between the 18th and 19th session. The modified orienting basis was launched in the form of text file, which enables a reader to type his or her questions immediately on the particular location of each meta-marker. Each meta-marker was endowed with modelling questions, elucidating its meaning at a general level. The orienting basis was expanded to include a 14th meta-marker “Frequency of appearance of the main issue”, which refers to different linguistic constructions, expressing the frequency of a concerned phenomenon. It was meant to draw a user’s attention to this ontological dimension in his or her questions on various topics.

**Participant’s questions and verbalisations**

The findings from the participant’s questions and verbalisations shed light on how the orienting basis enhanced his strategic question generation in processing expository texts and how the revisions of its guiding elements made during the intervention process contributed to the usability of the orienting basis in scaffolding question generation. The participant generated a total of 49 questions without externally leaning on the meta-markers or assisting words. Furthermore, he came up with 19 questions after being exposed to the one of the meta-markers and 17 questions associated with one of the assisting words uttered by the intervener.

The first three sessions were used by the intervener as a baseline in analyzing the content and structure of the participant's questions. The content analysis of these questions revealed that the information sought in them was related to such issues as locations, costs, duration, characteristics, time of existence and definitions of the concerned topics and activities related to them. Some of questions were verification questions or else based on preconceived notions not immediately related to the topic. For instance, after being exposed to the topic “Steps of Odessa”, the participant asked whether Odessa is a church. The topic “Media coaching” provoked the following considerations: “Why should you... why should you already know so much about the all medias in elementary school and why should you be able to use computer as early as the second grade?”

The participant was able to use the introduced external facilitators to expand the scope of the information that he sought in his questions. The semantic meta-markers thus led him to look into causal relations of the topic as early as during the second and third sessions. For instance, after being exposed to the meta-markers “Causes” and “Consequences” he came up with the following questions: “Why were the steps of Odessa originally founded?” , “What kind of consequences have there been for the environment or what chemicals got into the soil, when they were being built?” and “What are the consequences of learning media coaching?”

Some of the participant’s responses to the exposition to the meta-markers appeared to reflect his limited world knowledge. For instance, while being exposed to the orient-
ing basis in the 6th session, he did not see any sense in the use of the meta-markers IX (Forms of occurrence) and XI (Events), since he supposed that there was only one type of umbrella and that no particular history is related to it.

Separate questioning words and expressions also appeared to contribute to participant’s questioning. For instance, the word “why” was strongly associated to causal relations. It thus helped the participant to come up with questions such as “Why is it important to plan your work beforehand (learning activities) from the viewpoint of the meaningfulness of learning?” and “Why do the municipal home services exist?” The word “what?” in turn led the participant to ask questions like “What is hurricane Katrina?” and “What is meaningful learning about?” related to the basic definitions of the concerned phenomena.

The participant appeared to spontaneously employ some of the semantic constituents of the meta-markers in the later sessions in a way that did not transpire in his spontaneous questioning at the very beginning of the intervention. For instance, the participant spontaneously generated questions about how umbrellas and the domestic services of the city Helsinki work (the same word as activity in Finnish in this context), but not about work related to the recycling of computers although the latter topic can be easily be associated with various activities. The topic “Recycling of computers” was processed during the first session while “Umbrellas” was the selected topic of the 6th session. Moreover, when asking about “Sense-making learning” in the 7th session, he spontaneously came up with a very relevant question, “What phases are included in the learning process or in it as the whole?” but did not address the specific phases of the recycling as a process in his questions. The relevance of the question regarding the phases of the learning process was highlighted by the fact the regular phases related to meaningful learning were indeed discussed in the text being processed during the 8th session.

Some of the questioning words as well as the meta-markers did not shape the semantic content of the participant’s questions accurately enough. For instance, the participant associated the word “when” with the activities which take place regularly although this word was supposed to be related to the past events. The participant was also prone to link the meta-marker “Events (XI)” to regular, but not past, events. In the first session, and without assistance, he generated the question “What is recycling process like as an event?” and while being asked to link this question to some meta-marker he associated it to the meta-marker “Events”. The meta-marker “Phases (X)”, in turn, led the participant to generate a question about past activities although this meta-marker was meant to refer to the phases that used to occur regularly. While being exposed to this meta-marker in processing the topic “The stairs of Odessa”, he came up with the question: “What kind of working phases did the construction of the stairs of Odessa include?”

Consequently, the findings from the analysis of guiding interactive episodes indicate that the intervener needed to emphasize in his verbalisations some chronological and regular processual relations, which he wanted to be addressed in the participant’s questions, such relations being not sufficiently captured in the naming of the meta-markers. Moreover, the intervener’s initial observation that the meaning of the meta-marker “Properties (VI)” is not fully comprehensible to the participant led him to expand its heading with the expression “what is it like”.

In the sessions taking place during the second stage of the study, the participant repeatedly addressed causes of the particular phenomena in the open-ended, unassisted
questions generated. This can be seen as a significant advance. Unassisted at the outset of the intervention, he referred to the causes of the concerned phenomena in his questions only in a rather blurred way. The participant also once spontaneously asked about the purpose of the given phenomenon (“Carbon monoxide barrel”); he did not address it without assistance during the first 9 sessions.

The qualitative sequential analysis of the interactive guiding episodes and of the participant’s responses and questions permitted one to trace the following episodes that appear to have particularly drawn the participant’s attention in questioning to the ways in which the concerned phenomena can be affected:

In the 12th session, the participant did not see any relation between the sentences describing how temper tantrums can be alleviated and the meta-marker “The causes of the Red string and things affecting it,” nor did he regard the sentences as referring to how temper tantrums can be affected. Consequently, the intervener confronted him by pointing out that the ways of dealing with temper tantrums as a matter of fact can be seen as factors affecting them. In the 18th session and on his own, he linked a text fragment, which discussed how fears can be alleviated by talking about them, with the meta-marker II by formulating it: “How can the Red string being sorted out be affected”. In the 19th session, on the topic of stress, he spontaneously generated a question: “How can one try to reduce it?”

The exposure to some of the assisting words and expressions led the participant to generate questions, the semantic content of which can unequivocally be associated with separate meta-markers. The excerpts from the transcript of the 11th session in Table 6 present how the participant used the assisting expressions in generating questions on the structure and functioning of a carbon monoxide barrel.

Table 6. Excerpts from the transcript of the 11th session.

<table>
<thead>
<tr>
<th>Intervener</th>
<th>Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;And then: “What is it like?” “</td>
<td>“What kind of structure does the carbon monoxide barrel have?”</td>
</tr>
<tr>
<td>Excellent question!</td>
<td>(writing down) “By a structure I mean shape and stuff like, what it consists of.”</td>
</tr>
<tr>
<td>&quot;Okay, then we have got to the word “How?””</td>
<td>“How does a carbon monoxide barrel work?”</td>
</tr>
</tbody>
</table>

Data collected from Toni’s verbalizations in generating questions during the 20th sessions firstly with minimal assistance and then by leaning on the last version of the orienting basis provided some evidence indicating that its external use not requiring the recall of the meta-markers appeared to reduce Toni’s cognitive load when applying them to generate questions. As may be deduced from the latency times of the fragments of the 20th session during which questions were generated (Table 7), the participant required more time to recall the meta-markers than to come up with the questions applying them to the topic of the session.
### Table 7. Excerpts from the transcript of the 20th session

<table>
<thead>
<tr>
<th>Intervener's assigning and assisting verbalisations, assisting meta-markers</th>
<th>Recalled meta-markers, participant's questions and other verbalisations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Let's try to recall the points of the model. When some point comes to mind, please, think about the question. You can consider that vocational training is now the main issue.</td>
<td>(latency 5 sec) Properties is to say, what kind vocational training is available for the youth, if we aren't only thinking about me now</td>
</tr>
<tr>
<td>Okay</td>
<td>(latency 7 sec) Then, such things like... (latency 4 sec)... what's the structure of vocational training like. What elements does it consist of?</td>
</tr>
<tr>
<td>That's good. Do you remember what point it's related to? As a matter of fact, you mentioned it in your question. There was a point for it in the model, wasn't there?</td>
<td>Structure.</td>
</tr>
<tr>
<td>Okay, what about the other points, if we try to remember them from the order of the model? Do you remember what there was at the very beginning?</td>
<td>(Immediately) Definition was the first.</td>
</tr>
<tr>
<td>Erm (with an approving tone). What do you think, could there be a question from that?</td>
<td>(immediately) Toni: I haven't asked; what is vocational training?</td>
</tr>
<tr>
<td>Okay</td>
<td>(latency 16 sec) Toni: And then... (latency 6 sec)... parts. But structure and parts in this case are a little bit related to each other.</td>
</tr>
<tr>
<td>It's the same point in the model.</td>
<td>(latency 11 sec) Toni: And then... activity. What kind of activities are there at vocational schools?</td>
</tr>
<tr>
<td>(While using the meta-markers) Why is the main issue created (when created by man)?: &quot;Key expressions: The main issue is purported to, is aimed at, the objection is, the aim is, the goal is...&quot; (Meta-marker III: Purpose) What do you think could be a question about that?</td>
<td>(immediately) What was the purpose of the invention of vocational training in society?</td>
</tr>
<tr>
<td>(intervener)</td>
<td></td>
</tr>
<tr>
<td>&quot;Where the main issue: is located, is acting, is being realized? Where does it occur? (Meta-marker XII: Location) What do you think is it possible to ask about that? (intervener)</td>
<td>(latency 2 sec) Toni: Yes indeed.</td>
</tr>
<tr>
<td>What could you ask?</td>
<td>(immediately) Toni: Well... (latency 7 sec)... Where do they carry out vocational training in Finland? There is a lot of training in Helsinki, isn't there.</td>
</tr>
<tr>
<td>&quot;What are the forms of the main issue?&quot; Key expressions: i: &quot;X is one of the main issues; types, species, groups, races, forms fields, specialities&quot; (Meta-marker IX: Types) Intervener: What do you think about that?</td>
<td>(immediately) What fields can you graduate into from vocational training?</td>
</tr>
</tbody>
</table>
Results of the independent assessment of the participant’s questions

The sets of the participant’s questions extracted from the first (S1), third (S2), 19th (S3) and 20th (S4) sessions were presented to 47 independent evaluators in an order that did not correspond to their chronological order (the order of the presentation is summarized in Table 8). Only questions that were generated without meta-markers or by means of their recall and elaboration, but without external reliance on the orienting basis, were included in the sets.

Table 8. Table of questions presented to the evaluators

<table>
<thead>
<tr>
<th>Topic</th>
<th>Generated questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stress</td>
<td>“What is stress?”, “What does cause it?”, “How can one try to diminish it?” “When has stress come common?”, “Does one try to …these problems of working life…does one at least try to affect so that there would not be too much work?”</td>
</tr>
<tr>
<td>Media coaching</td>
<td>“What is media coaching?”, “What is media?”, “What kinds of things do they teach in media-coaching classes?”, “Why should one know a lot about medias already at elementary school and why should one know how to use computer already at second grade?”</td>
</tr>
<tr>
<td>Vocational training</td>
<td>“Properties is to say, what kind vocational training is available for the youth?” “What’s the structure of vocational training like?”, “What elements does the training consist of?”, “What kinds of activities are there at vocational training institutes?”, “When did vocational training become common in Finland?”, “Which social phenomenon has affected the fact that they have started to practise vocational training and what consequences has it had?”</td>
</tr>
<tr>
<td>Recycling computers</td>
<td>“What kind of places are computers recycled to?” “How much do these re-cyclings cost?”, “What is recycling process like as an event?”, “How much time does it take until a computer reaches its destination, how slow is the recycling process?”, “Does one need permission to recycle a computer?”</td>
</tr>
</tbody>
</table>

Statistically significant differences in the independent evaluations of the analyticity of the set of questions were found in the paired sample t-test between the evaluations with regard to the pairs S3- S1 (t(46) = 2.79, p<.01), S3-S2 (t(46)= 3.22, p<.01). With regard to the predictivity of the set of questions, significant differences in the evaluation were found between the pairs S3-S2 (t(46) = 3.74, p<.01) and S4-S2 (t(46)= -3.47, p<.01). It thus appears that the evaluators recognized the participant’s advancement in his ability to analytically consider the topics of the texts in his questions; they detected the increase of the predictivity of his questions. The results of the independent evaluation procedure thus support the conclusion that the use of partially internalized orienting basis resulted in gains in respect of the criteria being used in the evaluation.
Discussion

In the present study, we drafted and tested a conceptual meta-model performing the function of an orienting basis in scaffolding a blind young learner’s strategic questioning in processing expository texts. Drawing on the second sub-system of theory of planned stage-by-stage formation of mental actions and concepts, we endowed the orienting basis with conceptual elements intended to guide the participant to address, in his questions, ontological categories and coherence relations frequently featured in expository texts on various topics. In addition, the third subsystem of this theory was implemented in the intervention by guiding the participant through the use of the orienting basis in order to apply questioning strategies to various topics; he was required to distinguish essential categories, and relations around these topics, from inessential ones. Based on the evidence examined, we conclude that there is good evidence that the intervention resulted in gains in the participant’s strategic questioning.

The intervention episodes, according to our analysis, revealed that the meta-markers involved in the orienting basis for scaffolding a blind reader’s question generation can be widely used in mediating an intervener’s guiding activities. An intervener can use the meta-markers immediately to facilitate the blind reader’s questioning as well as his or her reflections on the content of texts being processed. The results of the study appear to indicate that both of these practices tend to contribute to the development of an intervenee’s questioning strategies. The participant of the study benefited from using the orienting basis in generating questions as well as from being pointed, by means of the meta-markers, to the coherence, dependent and conceptual relations that he was prone to ignore in processing texts. Exposure to the meta-markers and related intervener’s guidance during questioning led the participant to address important ontological categories and relations that he had missed in spontaneously generated questions. He also gradually started to implement these categories and relations in the questions that he generated without assistance. The immediate reflective use of meta-markers in processing text contents appeared to heighten the participant’s attention to a particular form of causal coherence relation; it was a form which he had been prone to ignore, but which he started to spontaneously address in his questions once it had been pointed out by the intervener.

The results of the study indicate that the developed and implemented orienting basis opens up an opportunity to re-represent and expand a blind learner’s world-knowledge in strategic question generation. In this regard, the participant of the present study appears to have particularly benefited from the intervener’s comments mediated by the orienting basis and counteracting his propensity to ignore such ontological categories as historical stages and types which relate to the concerned phenomena.

The results also suggest that it is legitimate to endow an orienting basis used for scaffolding a blind learner’s questioning in text processing with conceptual elements that sufficiently guide him or her to take into consideration various ontological categories and relations. That such categories and relations are easily ignored may be due, in part, to the lack of a blind person’s visual access to their real existence in daily life. Given the large body of findings about the facilitative effect of strategic questioning on reading comprehension, it appears plausible to propose that the account of these cat-
Categories and relations in antecedent questions leads a learner to pay particular attention to the corresponding coherence relations in the expository text that he or she is about to read. In the present study, such elements as words referring to ontological categories (for instance “purpose”, “part” and “type”) and to relations (for instance “affecting” and “consists of”) as well as generic questions and other expressions elucidating their meanings (For instance “Where the main issue: is located, is acting, is being realized?”) turned out to be useful in customizing the orienting basis for the scaffolding of strategic questioning.

In the present study, we drafted an artefact that enables a learner to organize his orientation to new texts as well as to process them in an externalized form. We propose that the appropriation of the external use of an orienting basis, which facilitates the predictive generation of questions and the structuring of a learner’s reading of expository texts, should be one of the central practices in interventions scaffolding the reading comprehension of blind learners of the kind mentioned here; persons with several impairments with regard to their executive skills, memory processes or linguistic functions. Completely internalized regulation, deriving from the external use of the orienting basis, can thus be invoked as a possible, incremental outcome of long-term externalised regulation. Such regulation, in its advanced form, helps a learner to cope with his or her daily learning challenges.

Given the clinical-case-study nature of the present study, its results cannot be generalized directly to other similar cases. Further, the relative contributions of the various components of the intervention cannot be determined from the present data. The study focused on designing the orienting basis as well as on the scaffolding and development of the participant’s strategic questioning. The immediate effect of the intervention on the participant’s reading comprehension was, thus, not investigated. The first author will explore, in his further studies, how the orienting basis can be used more generally in supporting blind learners’ text processing in extracting knowledge from various textual sources. The assessment of the interventional effect on the participant’s comprehension skills as well as the usability of the orienting basis in various interventional contexts will be addressed in these studies.

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**Biosketches**

**Kari Kosonen** has a background in the developmental psychology. He is currently working as a researcher at the Department of Psychology in the University of Helsinki in an international project developing pedagogical and technological solutions for supporting collaborative knowledge creation processes. Prior to this work Kosonen served as a certified developmental psychologist in a family counselling centre providing diagnostic and rehabilitational services for learners with specific pedagogical needs. In his current work and doctoral studies he designs and tests conceptual scaffolding tools for addressing specific learning challenges stemming from the complexity of a target domain or a learner’s own individual needs. Kosonen applies and explores a theoretical framework based on the Activity
theory and particularly the writings of Vygotsky, Leontiev and Galperin that he was familiarized with, in their original language, during his psychologist training at the Moscow State University.

Minna Lakkala has a background in general psychology and computer science. She has an extensive experience of in-service teacher training in the educational use of information and communication technology. She has participated in large national follow-up studies concerning school development through ICT (Educational technology projects of Helsinki and Espoo cities), and several international research projects (Netd@ys 1999 Evaluation, ITCOLE, P2P, Celebrate, Ernist, KP-Lab) concerning the pedagogical use of technology at schools and higher education settings. Currently she is a researcher at the Technology in Education Research Group in the Department of Psychology at the University of Helsinki. Her main research interests relate to the issues of pedagogical design of and students’ scaffolding for technology-mediated collaborative inquiry and innovative knowledge practices.

Kai Hakkarainen, Ph.D., is an acting Professor of Empirical Education at the Department of Education, University of Helsinki. Simultaneously, he is the co-director of the Centre for Research on Activity, Development and Learning (CRADLE) at the Department of Education (about Hakkarainen’s formed research centre, see www.helsinki.fi/science/networkedlearning). With his colleagues, Hakkarainen has, for 15 years, carried out learning research based on psychology and cognitive science at all levels, from elementary to higher education. Many investigations have included a strong theoretical component, and have addressed how learning and human intellectual resources can be expanded using collaborative technologies based on the information and communication technologies. During recent years, Hakkarainen’s research activity has expanded toward investigating personal and collective learning processes taking place in knowledge-intensive organizations, including innovative private corporations. Simultaneously, his investigations, originally oriented toward cognitive study of individual learning, have moved toward socio-cultural and activity-theoretical research and development of his own ‘trialogical approach’. Hakkarainen’s research unit has been strongly focused on international, scientific publications, gaining both national and international recognition.