Facilitation of Understanding in Distributed Orienting Activity

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Academic dissertation to be publicly discussed, by due permission of the Faculty of Behavioural Sciences at the University of Helsinki in Auditorium 12, Fabianinkatu 33, on the 19th of September, 2015, at 12 o’clock

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Abstract

Over the past decades the sense making of learners by means of various external models and representations has received educational researchers’ heightened attention (Ainsworth, 2006; Hay & Kinchin, 2006; Furberg et al., 2013). Similarly, the particular function of domain-specific concepts in the transformation of learners’ thinking and understanding remains an issue repeatedly approached from the perspective of various theoretical frameworks and empirical findings (Land, Rattray et al., 2014; Meyer & Land, 2005). The present doctoral thesis sheds light on how the learners that aim to understand multifaceted conceptual objects can be supported by the instructional tools sensitive to the specific conceptual organization of these phenomena. The thesis includes four studies. Studies I-III focused on the development and testing of an instructional meta-model based on frequent expository text structures with blind readers. Study IV explored the use of modeling language based on this model in a domain-specific pedagogical setting in higher education.

Studies I-III aimed to develop and explore the use of a conceptual meta-model in guiding the young blind participants to process such complex conceptual objects as expository texts in reading for understanding. The context of Study IV remarkably differed from the contexts of Studies I-III due to the specific conceptual dimensions of the topic of the investigated seminar, which were qualitative and mixed methods. While the pedagogical challenges of Studies I-III were related to the participants’ blindness and their problems in cognitive functioning and with the structures of the processed text, the conceptual complexity of the topic of the investigated seminar on qualitative and mixed methods, in turn, constituted the main pedagogical challenge in Study IV. The meta-model was used as a generic conceptual frame in designing the context-specific modeling language to highlight some crucial concepts and conceptual relations suggested to be used in digital concept mapping. To circumvent the limitations of the conventional hierarchical structure of concept maps the modeling language used was endowed with specific elements, language codes. These codes were meant to afford the processing of both static conceptual relations and various practice related and functional dependencies in the domain when the participants created concept maps on qualitative and mixed methods.
In all four studies the participants’ activities investigated were theoretically conceptualized and operationalized as various forms of orienting activity mediated by cultural tools. This theoretical focus of the present dissertation study is based on the Cultural Historical Theory founded by Vygotsky and psychological activity theory framework. However this framework is integratively implemented capitalizing on some contemporary theoretical perspectives and practical approaches in pedagogical design and developmental psychology. Consequently, learners’ activity and instructional discussion are explored as joint orienting activity shaped by cultural tools. This activity is considered to organize various relations and properties underlying the phenomenon being concerned with a point of view that constitutes the perspectival understanding of this phenomenon. The case-study research strategy implemented in the research made it possible to analytically generate a large body of findings that inform practitioners about the potentially applicable ways of using the approach investigated in pedagogical settings.

In Study I the participant was found to have internalized the elements of the meta-model as a thinking tool in processing and reflecting on a wide variety of conceptual topics. The findings from both Studies II and III shed light on how the use of the elements of the meta-model allowed the intervener to adjust his guidance to the current form of the blind participants’ thinking. In Study II the participant’s elaborative questions in processing expository texts were found to have transformed in respect to their analyticity and predicted better than previously the content of the texts processed. In Study III the participant was found to gradually incorporate some of the elements of the meta-model as part of his text-structuring actions, which increasingly drew his attention to the frequent expository text-structures that he was previously prone to ignore or misinterpret. In Study IV the participants were found to repeatedly implement some of the contextualized and digitalized elements of the meta-model in elaborating on various dimensions of the field of qualitative and mixed methods as well as the related practices. This repeated use of selected codes supported the maintenance of some conceptual stability of the informational content of the elaborations in the participants’ concept maps. The teacher of the investigated seminar was found to repeatedly lean on these elaborations in guiding the participants in how to further deepen their knowledge on qualitative and mixed methods.
Tiivistelmä


Acknowledgements

The initial foundation for this work was laid by my family friends who requested me to do something to help their daughter to deal with the increasing complexity of her school book texts. This request and the subsequent attempts that I made to fulfill it, changed my life since I encountered a completely new challenge – a need to make various expository text materials somehow more accessible to a young learner who had lost her sight. At the same time I felt increasing interest in the potential usefulness of the Galperinian theory in work with the children having special educational needs.

Tuike Merisaari was the person with whom I initially started to use the modeling framework that I have explored in the present research. Since she apparently benefited from it, that became the first impetus to my research work. In this regard, I want to thank both Tuike and his parents Anne and Rauno Merisaari for participating in tailoring the modeling framework in its initial state in the home environment. I subsequently took various opportunities to read Piotr Galperin’s writings that I had previously gotten to know during my training at Moscow State University. The second element that helped my investigational endeavor to get off the ground was a friendship with Professor Kai Hakkarainen who by encouraging as well as assisting me in working on scientific writing led me to focus my mind on the present research and present it as doctoral thesis. I also want to express my gratitude to Anne Merisaari for editing a networked book that portrays the lives of the three pre-term born young people who participated in my study and also describes my work with them in a way understandable to a wide variety of readers.

The work on my doctoral thesis would not have become possible without an opportunity to take time away from the daily hustles and bustles related to the practical work of a developmental psychologist. I have received financial funding from Emil Aaltonen’s, Fund, Ella and Georg Ehnrooth’s Fund and the Blind Children’s Parents’ Supportive Fund and thus want to express my humblest gratitude to these people that provided me with financial support in my research work. I also want to pay my respects to my former employer, the municipality of Mäntsälä which accepted my application for a job alternation leave in 2005. This opportunity, in turn, opened up a completely new
path in my working experience, when I was recruited as a project researcher to an international research and developmental project, called Knowledge Laboratory Project.

Working in the Knowledge Laboratory Project I got to know sophisticated investigators who greatly helped me to acquire qualitative research methods and also gave me valuable feedback and guidance in scientific writing. In particular, I want to express my sincerest gratitude to Liisa Ilomäki and Minna Lakkala, who participated in the co-writing of my papers and made an irreplaceable contribution to improving the comprehensibility, argumentation and coherence of the manuscripts. Also I want to thank Merja Bauters, Crina Damsa, Martin Dörr, Satu Jalonen, Jiri Lallimo, Hannu Markkanen, Hanni Muukkonen, Sami Paavola, Christoph Richter and Seppo Toikka, from whom (during collaboration in the Knowledge Laboratory Project) I also got inspiring ideas for work on my own thesis. This collaboration also remarkably expanded and enriched my theoretical perspective in framing the approach underlying my own doctoral study.

Working with Merja Bauters I have had a pleasure to implement and develop the pedagogical framework explored in my doctoral studies in practice in guiding the students attending the courses on semiotic methods which Merja gives at the Helsinki University. The ideas and solutions from these courses played a pivotal role in developing the scaffolding solutions realized in the Seminar on qualitative and mixed methods, these were investigated in Study IV of my thesis and instructed by Liisa Ilomäki. I also found very inspiring the collaboration with speech therapist Marja Liikanen implementing the meta-model that I developed in my research in her clinical work. Marja remarkably enriched this implementation with her own ideas. Working as a part-time course instructor in the city of Sipoo and currently as a school psychologist in Mäntsälä I have had an opportunity to implement some ideas related to cultural tools that I have developed in my thesis in practical educational settings. In this respect I want to thank the principal Aarne Alatalo and teachers Juha Kuusela and Tommi Kurppa working at Sipoo Upper Secondary School, as well as Principal Tuula Ivonen, and teachers Sirpa Repo and Jaana Nieminen working at Mäntsälä Upper Secondary School.

The cumbersome process, through which my manuscripts gradually became papers published in scientific journals, has been a great learning opportunity. Besides the
aforementioned friends to whom I have already expressed my gratitude I want to thank Antti Seitamaa for the translation of the first draft of the first original paper and the language editor Hall White who helped to advance the first three original publications included in my research and the introduction of the thesis. Hal’s contributions were not limited to language correcting but also entailed valuable comments on scientific argumentation. In addition, Jason Selvarajan’s assistance in translating some sections of the transcribed data quoted in the original papers has been helpful. I also appreciate the comments of journal editors Beatrice Ligorio, Jaan Valsiner and Sergio Salvatore that have greatly encouraged and helped me in amending the submitted manuscripts. This feedback has been particularly valuable given the fact that my studies were explorative as well as developmental by their nature, and their concise reporting has consequently posed a specific challenge.

Given the diversity of the studies of my thesis, it has been challenging enough to convert the theoretical rationale and findings into a coherently and concisely framed theoretical introduction. In this regard I have received particularly valuable advice related to contemporary cognitive paradigms from Prof. Kai Hakkarainen. The docent Ritva Engeström, my second supervisor, in turn, has remarkably assisted my work by providing vantage points from the perspective of Activity Theory. Ritva’s honest curiosity towards the ideas and their realization in my research has greatly encouraged and motivated me to repeatedly delve into the summary of the thesis to make it more comprehensible. In addition, Ritva has given thoughtful advice allowing me to re-organize the separate sub-section of the theoretical introduction of the thesis and replace some related concepts to improve its comprehensibility to a reader. Finally, I want to thank Liisa Ilomäki for valuable feedback regarding the section which portrays and reflects on the research strategy and research techniques used as well as trustworthiness issues in the introduction. And last, but not least, I want to thank the preliminary examiners of my thesis, Professor Andrey Podolsky and docent Jussi Silvonen for the thorough evaluation of my research and inspiring comments.
List of original publications

This thesis is based on the following publications, which are referred to in the text by their Roman numerals (Studies I-IV)


### Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>DCog</td>
<td>Distributed Cognition</td>
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<tr>
<td>OBA</td>
<td>Orienting Basis of Action</td>
</tr>
<tr>
<td>OTS</td>
<td>Operational Thinking Schema</td>
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<tr>
<td>PI</td>
<td>Progressive Inquiry</td>
</tr>
<tr>
<td>PSFMA</td>
<td>Planned Stage-by-Stage Formation of Mental Actions and Concepts</td>
</tr>
<tr>
<td>SST</td>
<td>Structure Strategy Training</td>
</tr>
<tr>
<td>TCU-NLM</td>
<td>Texas Christian University Node-Link Mapping</td>
</tr>
<tr>
<td>TSBS</td>
<td>Text-Structure-Based Strategy</td>
</tr>
<tr>
<td>ZFM</td>
<td>Zone of Free Movement</td>
</tr>
<tr>
<td>ZPA</td>
<td>Zone of Promoted Action</td>
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<tr>
<td>ZPD</td>
<td>Zone of Proximal Development</td>
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1 Introduction

Over the past decades the use of various external models and representations in learners’ process of sense making has received a great deal of attention of from educational researchers (Ainsworth, 2006; Greeno & Hall, 1997; Jitendra et al., 2011; Hay & Kinchin, 2006; Kozma, 2003; Furberg et al., 2013; Landet al., 2014; Novak & Cañas, 2006). At the same time the function of domain specific concepts in the transformation of learners’ thinking remains a live issue approached from the perspective of various theoretical frameworks and empirical findings (Anderson & Kratwohl, 2001; Hedegaard, 2002; Land et al., 2014; Meyer & Land, 2003; 2005; Monte-Sano & Budano 2014; Reiser, 2004).

A relatively recent theoretical framework of “threshold concept” (TC) assumes the value of domain-specific concepts that transform learners’ thinking or understanding in a way that allows things formerly not perceived to come into view (Fouberg, 2013; Meyer & Land, 2003; 2005). While this theoretical framework has been mainly used in higher education, it has also been recently implemented to address learning challenges at high school level (Park, 2014). The present research aimed at developing conceptual tools designed in the form of external representations partially functioning in a same way as threshold concepts. However, these tools were designed both in generic and domain-specific form. The present thesis explores conceptually mediated orienting activity as a cognitively intensive learning process that allows an instructor to adjust the guidance according to a learner's individual needs and interests related to the main object of learning. The theoretical basis of the research goes back to the Cultural-Historical Theory founded by Vygotsky and continued by Piotr Galperin (Podolsky, 2002) in his works. The theoretical framework of the thesis combines these theoretical underpinnings with more recent frameworks in the field of instructional sciences.

The thesis includes four studies that are referred to as Studies I-IV. They focused on how the learners seeking to understand multifaceted conceptual objects can be supported by the elements of a conceptual model highlighting the specific conceptual organization of these objects. In the original studies the elements of the model were used to engage the participants in external cognitive movements that re-represented the objects that they were processing and expanded their current understanding of these
objects. Studies I-III focused on the development and testing of an instructional meta-model to enhance blind readers’ understanding and processing of expository text structures in reading. Study IV explored the use of a specified modeling language based on this meta-model in a domain-specific pedagogical setting in higher education where the participants were studying research methods.

Studies I-III aimed to develop and explore the use of a conceptual meta-model in guiding the young, extremely preterm born (24-26 weeks of pregnancy) blind participants to process such complex conceptual objects as expository texts and come to understand them. Reading comprehension, in general can be defined as conceptual knowledge built from text (Taboada et al., 2012). Similarly, Graesser (2007) defined a reading comprehension strategy as a cognitive or behavioral action that is undertaken in some contextual condition with the goal of improving some aspect of understanding. The higher-level cognitive functions required in the comprehension of domain-specific texts have been characterized as strategic and meta-cognitive by their nature. ‘Strategies of reading and learning’ refers to concrete understanding of the material being read and associated memory-assisting functions (Aarneutze et al., 1998; Lederer, 2000; Palincsar & Brown, 1984). Such strategies as predicting text contents, devising context-related questions, general eyeing of the text, activating background knowledge of the themes of the text, rearranging the content of texts, and making inferences and drawing conclusions have been found to play a crucial role in reading comprehension. Due to blindness and diverse problems of cognitive functioning (Hack, et al., 2004) the participants of Studies I-III had specific, exceptional educational needs in learning text comprehension strategies.

The conceptual complexity of the topic of the investigated seminar, qualitative and mixed methods, constituted the main pedagogical challenge in Study IV. To fully capture this complexity in their concept maps students have, besides various static conceptual relationships, to also process functional and procedural relationships and dependencies underlying the use of qualitative research strategies and techniques. Even in higher education, students’ capacity to coherently and flexibly represent multifaceted conceptual relations cannot be taken for granted (Bramwell-Lalor & Rainford, 2014; Hay & Kinchin, 2006; Pinto et al., 2010).
Concept mapping is demanding knowledge structuring activity particularly due to the requirement on the learner to linguistically explicate diverse conceptual relations (Pudelko et al., 2012). The widely used hierarchical structure of concept maps may not optimally support the modeling of functional relations, dependencies and sequential content, such as processes, time-lines or developments (Davies, 2011; Eppler, 2006; Safayeni et al., 2005). Conventional concept maps also do not afford a concise separation of concepts of critical importance from those of secondary importance (Daley, 2004). Findings from various concept mapping interventions investigated in higher education have motivated calls to devote more attention to domain-specific representational guidance in concept mapping, particularly at the outset of a learning process (Bramwell-Lalor & Rainford, 2014; Kinchin, 2014; Pudelko et al., 2012). The studies on the concept-mapping interventions in higher education based on this kind of guidance have yielded some promising results in respect of learning outcomes (Kumar et al., 2011; Oliver, 2008; Wu et al., 2012).

Study IV explored how a domain-specific modeling language based on the heuristic use of the meta-model that was developed in Studies I-III can be implemented to support students in higher education in creating concept maps concerning the use of qualitative and mixed methods. The meta-model was used as a generic conceptual frame in designing the context-specific modeling language in order to highlight some crucial conceptual and relational structures in the field of qualitative research. Whereas, the elements of the meta-model used in Studies I-III highlighted more generic knowledge structures in expository texts, the elements in Study IV were used to highlight domain-specific knowledge structures. Unlike the situation in the aforementioned studies of the use of representational guidance (Kumar et al., 2011; Oliver, 2008), the participants were not required to use predefined concepts in their concept maps but were provided with more open domain-specific and coherence-supporting conceptual guidelines.

In the present research the participants’ externalized cognitive movements (Reshetova, 2004) mediated by cultural tools as well as related guidance were made the focus of the exploration. The original studies of the thesis explored the participants’ orienting activity directed to multi-faceted conceptual objects (expository texts, their topics and the field of qualitative research). The elements of the meta-model developed in the research were used as cultural tools to help the participants to coherently organize
their elaborations and related knowledge in orienting towards the aforementioned conceptual objects. Due to this characteristic of the research theoretical concepts including a) zone of proximal development (ZPD), b) scaffolding c) cultural tools, and d) mediation played a central role in its theoretical background. In all four studies of the present thesis, participants’ activities under investigation were theoretically conceptualized and operationalized as various forms of orienting activity (Galperin, 2002) mediated by cultural tools. In this regard, the role of cultural tools was considered to reside, as Vasiliuk (1984) pointed out, not only in augmenting the possibilities of an acting subject but also in providing activity with a form and structure. In what follows the theoretical framework of the present research is presented in more detail.

2 Theoretical framework

In this section the concepts ZPD, scaffolding and cultural tools are first discussed; the author distinguishes cognitive and meta-cognitive mediation as two, diverse mediatory mechanisms of scaffolding. The next sub-sections explore the representational content of cultural tools and learners’ guided actions as overlapping but still separate mediators of learning. The implementation of cultural tools is clarified from the perspective of the conceptual distinction between orientation-exploratory and executive components of action. Subsequently, the instructional approaches based on the systematic formation of learners’ actions and their orienting bases and the conceptualization of orientation as activity are discussed in relation to the processing of various forms of knowledge. The implementation of these approaches is also clarified.

In the next sub-section the author characterizes instructional discourse as distributed orienting activity, mediated by cultural tools. This process is considered to organize the given phenomena and some of their dimensions in relation to each other with a point of view that constitutes the perspectival understanding of these phenomena. Cultural tools are considered as the schematized representations of domain-specific entities and actions that are used by learners and instructors in order to create the perspectival understanding of some phenomenon. Subsequently, there is a discussion of various dimensions of expository text-structures considered as the cultural tools implemented in the present research.
The last chapter of the theoretical sections concerns the participants’ distributed orienting activity promoted and investigated in the original studies as acting with scaffolds within the varying degree of freedom. Finally the aim of the present research and research questions are presented.

A more detailed summary of the structure of the theoretical section of the summary and the key-concepts is presented in Table 1.

**Table 1.** The structure of theoretical section, key-concepts and referred authors in the summary of theoretical framework

<table>
<thead>
<tr>
<th>Sec.</th>
<th>Main content</th>
<th>Key concepts and referred authors</th>
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<tbody>
<tr>
<td>2.1</td>
<td>The section concerns the relation of concepts of scaffolding and zone of proximal development to the use of different cultural tools. It also clarifies how the present study particularly explores cognitive mediation in scaffolding.</td>
<td>Zone of proximal development (Vygotsky, 1978), scaffolding (Wood et al., 1976 ) meta-cognitive and cognitive mediation (Karpov &amp; Haywood, 1998), conceptual scaffolds (Hannafin, 2001), cultural tools (Stetsenko, 1999)</td>
</tr>
<tr>
<td>2.2</td>
<td>The section portrays the cultural tools implemented and developed in the present study as schematized representations that learners use reflectively.</td>
<td>Cultural artifacts (Cole &amp; Wertsch, 1996), reflective and non-reflective use of resources. (Gillespie &amp; Zittoun, 2010), cultural tools (Stetsenko, 1999)</td>
</tr>
<tr>
<td>2.3</td>
<td>The section discusses the use of cultural tools in promoting learners’ orientation as specific activity</td>
<td>Developmentally acquired standards and measures (Arievitch &amp; Stetsenko, 2000; Elkonin, 1971; Zaporozhets,1965), orienting basis of action (Elkonin, 1989; Galperin, 1992)</td>
</tr>
<tr>
<td>2.3.1</td>
<td>The sub-section explores the representational content of cultural tools and learners guided actions as facilitators of learning implemented in the present study.</td>
<td>The theory of planned stage-by-stage formation of mental actions and concepts (Galperin, 1992), three types of instruction (Arievitch &amp; Stetsenko, 2000; Galperin, 2002), empirical and theoretical thinking (Davydov, 1990)</td>
</tr>
<tr>
<td>2.3.2</td>
<td>The sub-section is a discussion of the present study from the perspective of the use of cultural tools in the systematic formation of learners’ actions and their orienting bases.</td>
<td>Orienting activity, exploratory, planning and monitoring/evaluative components of orientation (Galperin, 2002; Reshetova, 2004); conceptual knowledge (Anderson &amp; Kratwohl, 2001), declarative knowledge (Shavelson et al., 2005), situative knowledge (deJong &amp; Ferguson-Hessler, 1996), procedural knowledge (Anderson, 2006), planning knowledge (Van</td>
</tr>
</tbody>
</table>
2.3.4. The sub-section deals with the pedagogical design explored in the present study as an instructional discourse that creates a perspectival understanding of some topic.

2.3.5. The section introduces expository text structures as specific cultural tools implemented in the present study. The meta-model representing these structures presently developed is introduced.

2.4. The section specifies action as unit of analysis in the present research. The aim of the present research and research questions are presented.

2.1 Zone of proximal development and scaffolding

The present research explores the use of an instructional artifact (meta-model) that was developed in the author’s original studies in which he assisted the participants in processing complex conceptual objects. The purpose of the instructional use of the meta-model was to help the participants to make advancements that were beyond their reach without assistance. This objective is closely related to the concept of the zone of proximal development introduced by Vygotsky (1978). The understanding of the concept itself in the field of educational sciences has evolved under the influence of the multiple interpretations reflecting the diversity of views and theoretical perspectives on human development and learning.

The most quoted of Vygotsky’s definitions of the ZPD specifies it as the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under an adult’s guidance or in collaboration with more capable peers (Vygotsky, 1978). This definition emphasizes the interactional dimension of the concept. In his later writings Vygotsky (1962; Valsiner & van der Veer, 1993), however, framed the concept of ZPD in the context of the development of conceptual thinking. According to Vygotsky, the development of spontaneous, everyday concepts and subject-matter concepts constitute two, initially separate, lines in a child’s development. The spontaneous concepts develop from bottom-up reflecting children’s everyday practical experiences while the
subject-domain concepts are acquired through being exposed to the definitions and relations in some domain.

Vygotsky assumed that subject-domain concepts can take the role of cognitive mediators of thinking if they are concisely anchored to a child’s everyday concepts and practical experiences in the target domain of learning within the ZPD. In this case the learner becomes capable of applying advanced features of the scientific concepts (e.g., their higher level of reflectivity and systematic inter-conceptual relations) to the use of everyday concepts.

Vygotsky’s concept of mediation is closely related to the process of equipping a developing person with such mental tools as language, signs and symbols (Karpov, 2003). However, the prevailing interpretation of ZPD and related elaborations have not capitalized on the sign mediation processes as broadly as the earlier formulations of the concept, these emphasized the role of instructor-learner interaction. According to Stetsenko (1999) the understanding of ZPD separated from the idea of cultural tools can entail the view that an adult’s help exerts influence on a child’s development irrespective of the exact content of this assistance. Consequently, the way instructional tools reflect the target content of learning is not fully capitalized on (Arievitch & Stetsenko, 2000).

The notion of ZPD motivated the creation of concept of scaffolding in the 1970’s. Wood, Bruner and Ross (1976) framed scaffolding as a process through which the more competent partner controls the elements of the task that are beyond the learner’s reach and fades this control gradually when the learner becomes capable of completing these elements. The concept of scaffolding has been applied widely in designing and investigating pedagogical settings in which learners collaborate with others within their zone of proximal development (Brown & Palincsar, 1989; Bruner, 1990; Rogoff, 1990). Also, researchers have given increased attention to the peculiarities of instructive actions providing the basis for the future independent learning of an individual and to the progressive relocation of scaffolding agency from teachers to learners. (Cole, 1996; Holton & Clarke, 2006; Marshall, 1995; Scardamalia & Bereiter, 1985a; 1985b). There are at least three features that allow ZPD to be realized in scaffolding 1) dialogic character of the discourse in which knowledge is constructed, 2) the character of activity
in which knowing is embedded, and 3) the character of artifacts that mediate knowing (Wells, 1999).

Preserving the distinction between scientific and spontaneous concepts introduced by Vygotsky, Karpov and Haywood (1998) distinguished ‘cognitive mediation’ based on the scientific analysis of objects or events in various subject domains from the approach that they called ‘meta-cognitive mediation’ in scaffolding. As they pointed out, cognitive, content-specific mediation was what was particularly elaborated by Vygotsky’s students in Russian instructional psychology.

Some western instructional designers and researchers, in a similar vein as Karpov and Haywood, distinguished conceptual, subject-matter-specific dimensions of scaffolding from the related metacognitive dimensions (Askell-Williams et al., 2012; Ge & Land 2004; Hill & Hannafin 2001; Reiser, 2004). Conceptual scaffolds mainly accounting for cognitive mediation in scaffolding are considered by Hill and Hannafin [similarly to Anderson-Inman and Zeitz (1993)] as means used to assist learners in deciding what to consider or to prioritize as important. Reiser (2004) emphasized the role of conceptual scaffolding in construing problems that requires students to use the important epistemic features of the discipline and reframe their own ways of thinking in terms of these features. Ge and Land (2004) delineated their scaffolding framework partially adhering to the explicit distinction between the cognitive and metacognitive requirements related to ill-structured problems. Cognitive requirements are related to both the domain-specific knowledge and structured knowledge needed in solving problems in a particular area.

According to Karpov and Haywood the development of instructional practices in western pedagogical design has particularly emphasized the use of semiotic tools immediately related to the guiding interactions that an instructor organizes with a learner. This kind of meta-cognitive mediation in scaffolding serves the acquisition of such semiotic means of self-regulation in learning as planning, self-monitoring, self-checking and self-evaluating (Karpov & Haywood, 1998). These tools and strategies can be implemented in various learning contexts irrespective of the specific domain or contents that are addressed in learning. Such pedagogical frameworks as problem-based learning (Gijselaars, 1995; Hmelo-Silver & Barrows, 2006; Savery, 2006), knowledge building (Scardamalia & Bereiter, 2003), progressive inquiry (PI, Hakkarainen, 1998;
Muukkonen et al., 2004) and reciprocal learning method (Palincsar & Brown, 1984) can be viewed as examples of learning approaches that mainly implement meta-cognitive mediation in scaffolding. Reciprocal reading comprehension interventions guide learners to implement such strategies as summarizing, questioning, reflecting on and clarifying the difficult elements of texts and predicting text content in their reading process (Palincsar & Brown, 1984).

The meta-model developed and explored in the present research, however, is based mainly on the implementation of cognitive mediation in scaffolding. Its primary foci are, in general, not those just described. The prefix “meta” in this context, is not applied to cognitions, but refers to the abstractions that represent diverse, expository text-structures. There are several reading-strategy-approaches that capitalize on specific cognitive mediation in scaffolding somewhat along the lines of the present study. These include Structure Strategy Training (SST; Meyer & Poon, 2001; Meyer & Wijekumar, 2007), Text-Structure-Based Strategy (TSBS; Bakken et al., 1997) and Texas Christian University Node-Link Mapping (TCU-NLM; Dansereau, 2005; O’Donell et al., 2002).

The elements of the meta-model developed in the present research were used in a similar way as the question prompts (see Ge et al., 2005). These are not followed in an algorithmic fashion but are to be considered systematically as potentially implementable representational aids. This mode of implementation of the elements of the model capitalizes on the account of cultural tools as schematized representations of ways of acting in human communities, these ways are reflectively adopted by a subject in his or her actions. In what follows this notion and its implications for the present research are discussed in more detail.

### 2.2 The role of cultural tools in learning and development

The instructional settings investigated in the present research were based on the systematic use of external artifacts as cultural tools in organizing knowledge and in giving guidance to the participants. Cole and Wertsch (1996) emphasized the role of acting with cultural artifacts as material entities and incorporation of a part of previously used material matter as an aspect of human action. Cole (1996) treats the concept of tool as a subcategory of the more general conception of an artifact. He pointed out that the ideality of an artifact is based on the changes of its material form
taken place in the process of its creation and use. Wertch (1998) assumed the value of the research on the human development in using various meditational means and acting with the material artifacts in a way that result in changes in an acting subject.

The way mediational means result in changes in an acting subject can be seen to a large extent to depend on how consciously he or she approaches these means and reflects on his or her actions with them. Gillespie and Zittoun (2010) pointed out that an activity theory framework (for instance Engeström, 1987; Cole, 1996) tends to focus on the exploration of tool mediation whereas the semiotic mediation tradition (Valsiner, 2007) emphasizes semiotic mediators as means of psychological actions. Gillespie and Zittoun introduced the distinction between the reflective and non-reflective use of resources that can be tools as well as signs. This notion distances the character of the resource from the peculiarities of its usage.

The main criterion in making the distinction between the non-reflective and reflective use of a resource according to Gillespie and Zittoun (2010) is whether the mind of the user is focused upon the goal or upon the resource. The distinction between non-reflective and reflective use of resources applied to the analysis of the regulation of mental functions can be seen to resonate with the focus of research on signs as mental tools used to regulate a subject’s own behavior and thinking (Silvonen, 2003; Vygotsky, 1982; 1997; Vygotsky & Luria, 1994). The function of mental tools can be attributed, for example, to various external representations that slow down the sense-making process (Furberg et al., 2013; Kinchin & Cabot, 2010).

In the present research, the elements of the meta-model served as conceptual resources meant to be reflectively used by the participants as scaffolds in processing complex conceptual objects. The elements were introduced to the participants as means to be used in reflecting on and interpreting the meanings of various elements and dimensions of the processed conceptual objects. In this respect they can be seen to have functioned in the studies as signs, the semiotic mediators of psychological actions. Such mental tools, in turn, can be assumed to take the form of cultural tools when they function as embodiments of certain cultural practices, crystallized templates of action and schematized representations of ways of acting in human communities (Stetsenko, 1999). In the present research the concept of cultural tools is used to refer to the
externalized conceptual tools functioning as semiotic mediators that are used reflectively.

The elements of the meta-model implemented in the present research were developed during the original studies as schematized representations of culturally evolved, expository text structures widely used to organize knowledge in expository textual discourse. This research is based on the notion that the use of cultural tools in learning is realized by two mediatory mechanisms, a) the content of cultural tools as schematic representations which reflect, in various ways, the target task or problem and b) cultural tools which are concretely used, in particular ways, in learners’ actions. In what follows these two mediatory mechanisms are described in the context of the conceptual distinction between orientation-exploratory and executive components of activity lying at the foundation of the concept of orienting activity.

2.3 Orientation in learning as culturally mediated activity
2.3.1 The mediatory role of the content in learning
The representational content of signs and the way how this content mediates human actions came to the fore in the studies of Vygotsky’s followers (Leontiev, Galperin, Zaporozhets and others) in the 1930s and 1940’s. This development continued the line of research that was founded by Vygotsky in his method of double stimulation. The studies of the role of the representational content of cultural tools emphasized the role of culturally evolved concepts, models and standards used in solving various domain-specific problems. The investigations by Vygotsky’s followers also aimed to capture how even the most elementary actions, such perceptions (acts of perceiving) are semiotically mediated by various, developmentally acquired standards and measures used to analyze surrounding objects (Arievitch & Stetsenko, 2000; Zaporozhets, 1965; 2002). They thus shed light on the type of mediation called by Karpov and Haywood (1998) as cognitive and interpreted by them to stem from Vygotsky’s theoretical work.

Elkonin (1977) considered the activities by means of which the child acquires a) socially evolved modes of action with objects and b) the criteria for distinguishing their various aspects as constituting one of the two main groups of dominant activities in the child development. The instructional approach developed and explored in the present research capitalizes on this two-fold nature of cultural tools. On one hand, the
participants were prompted to undertake culturally established actions (for instance questioning, summarizing, concept mapping) in processing the target material of learning. On the other hand, their actions were guided with a set of externalized conceptual scaffolds based on culturally established generic and domain specific ways of organizing knowledge.

Characterizing learning activity Elkonin (1989) emphasized that its primary goal is not the transformation of the object to which a learner’s external activity is directed, but the transformation of the *modes of the learner’s actions* required in transforming the objects. Elkonin highlighted the process of establishing the properties and elements of an object having functional significance for the learner’s subsequent action with this object as the process that constitutes the central content of learning. In the present research the role of properties and elements of this kind was attributed to the frequently found structures of expository texts in Studies I-III and to various conceptual entities, relations and functional dependencies underlying qualitative and mixed methods in Study IV.

Elkonin (1989) recognized that his notion of the acquisition of various modes of action as the goal of learning closely resembled Galperin’s concept of orienting basis. Given this view, the development of an orienting basis for a learner’s actions with the conceptual and material objects in some domain can be seen to constitute the immediate object of learning activity. The concept of orienting basis of action (OBA) is one of the cornerstones of the theory of planned stage-by-stage formation of mental actions and concepts introduced by Galperin (1992; 2002). It refers to the elements and conditions of the problem situation to which a learner orients him- or herself in acting. The concept of orienting basis as well as Galperin’s formation theory will be discussed in detail in the next section. The instructional use of cultural tools and related instructional design in the present research are first discussed from the perspective of Galperin’s formation theory, his classification of three types of instructions and the distinction between empirical and theoretical thinking introduced by Davydov. Subsequently, implementation of cultural tools is conceptualized and operationalized in relation to the separate components of orienting activity introduced by Galperin.
2.3.2 Use of cultural tools in systematic formation of learners’ actions

The present research explores the participants’ actions in processing multi-faceted conceptual objects as orienting activity that aimed at creating the overall image of these objects and various modes of action required to work with these objects. The conceptual objects in question were expository texts and their topics in Studies I-III and the field of qualitative and mixed methods in Study IV. In Studies I-III the pursued outcome of the participants’ orienting activity thus was the overall image of the central conceptual relations and dependencies of the topics presented in the processed expository texts. At the same time, another, more long-standing pursued outcome was the participants’ evolving understanding (actually functioning, acquired orienting basis) of how they could lean on the common expository text-structures in processing this kind of texts. In Study IV the participants’ orienting activity was explored as activity the outcome of which was the creation of external orienting bases for their own use of qualitative and mixed methods. The participants’ orienting-exploratory activity was put at the center of research in all original studies of the thesis. In what follows the conceptualization of orienting-exploratory activity is elaborated in more detail.

After the Second World War Zaporozhets in parallel with Galperin (1965; 1969; 1992; 2002; Haenen, 1996; Liders & Frolov, 1991; Podolskij, 1997; 2002) investigated and conceptually distinguished the orienting-exploratory and executive components (concrete ways of realizing activity) of activity. The orienting structure of a learner’s action in an instructional context was put at the center of research in Galperin’s and his collaborators’ studies in the 1950s. This development resulted in the creation of the theory of planned stage-by-stage formation of mental actions and concepts (PSFMA). This theory represents a systematic model of conditions that enable the emergence of new intelligent operations in external form and allow their further internalization.

Galperin (1965; 1969; 1992; 2002) separated four sub-systems involved in the formation of mental actions. The first subsystem comprises the conditions that ensure the learner’s motivation in a learning process. The second subsystem refers to the conditions that are required for the building of a necessary action or formation of its orienting basis. This sub-system particularly highlights the use of cultural tools in the form of models, schemas and charts. The third subsystem of the formation theory delineates the instructional conditions allowing a learner to distinguish conceptual
features of objects or problem situations from surface-level appearances and necessary parameters required to be addressed in actions from superficial ones. The fourth subsystem of this theory comprises the conditions that ensure the internalization of the action being acquired.

The PSFMA places particular value on the externally designed, so called Schema of Complete Orienting Basis of Action. Galperin distinguished three diverse ways of creating the schema of an orienting basis for a learner’s actions and correspondingly three types of instruction with different developmental potentials (Arievitch & Stetsenko, 2000; Galperin, 2002; Podolsky, 2002). According to Galperin, the first way of creating the schema of an orienting basis, traditional instruction does not provide a learner with sufficient tools and conditions to orient his or her actions towards the central characteristics of the task required to be taken into account in order to complete it correctly. The learner is familiarized with the general rules of problem solving and these rules are explained to him or her by using typical examples. Subsequently, the rules are memorized and applied in solving typical problems. Since many domain-specific implicit rules and regularities that an experienced person tacitly follows in his or her actions are not explicited to the beginner, the learner has to be exposed to a large number of trials and errors to acquire the sufficiently correct pattern of actions. In the second type of instruction, a learner is provided with necessary criteria, clues and algorithms of action converted into a generalized symbolic form. The second type of instruction provides the learner with domain-specific principles and structures of the domain-specific tasks, but is, however, generally based on empirical concepts that do not capture the inner logic of the domain. Therefore they can be applied only to a limited set of tasks.

Unlike the second type of instruction, the third type is systemic theoretical by its nature (Arievitch & Stetsenko, 2000), since it involves a theoretical analysis of objects, phenomena or events in various subject domains. The entities, concepts or elements in a subject domain are not approached separately, but considered in respect of their mutual relations. In such analysis, learners are guided to distinguish the essential characteristics of different objects and phenomena, to form theoretical concepts and use these concepts as cognitive tools in further problem solving and in a wider context than in the separate sets of tasks. The third type of instruction also puts emphasis on learner-driven
delineation of an orienting basis for his or her further actions in completing domain specific tasks or in working on domain-specific problems.

Galperin’s distinction between the second and third type of instruction in many respects converges with Davydov’s (1982; 1988; 1998) distinction between empirical and theoretical thinking in supporting learners’ orientation to problem solving (Davydov, 1990; Arievitch & Stetsenko, 2000). Davydov argued for the need to transform the practices of teaching into the pedagogical settings that guide learners to implement the specific modes of analysis and generalizations underpinning various systems of scientific concepts. Adhering to the core assumptions of dialectical logic (Ilyenkov, 1977), Davydov pointed out that theoretical thinking aims at establishing the essence of its target phenomenon within the development of a whole system that determines the relations of the phenomenon with other objects and phenomena. According to Davydov, empirical and theoretical thinking differ in respect of their content. Empirical thought is based on generalizations of the features of the objects and phenomena considered to exist as particular and independent realities. Theoretical thinking is based on ascending from abstract to concrete and realized in the implementation of general domain-specific principles in the analysis of particular relations that characterize some object, phenomenon or case related to the domain.

Both Galperin and Davydov implemented model-based approaches capitalizing on cultural tools in instructional design. The second sub-system of Galperin’s formation theory emphasizes the use of a Schema of Complete Orienting Basis of Action designed in the form of an external model or diagram. It represents the essential elements and relations requiring account in executing the new actions. Consequently the learner is first introduced to the new actions at the material level in working with OBA in the form of a model, diagram or drawing which depicts the essential properties and relations for the actions. 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 et al., 2002) to educational settings aiming to shape students’ analytical skills in higher education (Reshetova, 2004). Thus, for instance, Porshnev (Oboukhova et al., 2002) developed a particular form of electronic orienting card serving as an instructional component in the software designed for teaching French. This component represented to
learners the specific grammatical information needed in forming various sentences that use French verbs in the past tense.

Davydov (1982) developed an instructional approach based on the use of ‘initial cells’, models that in a purified form expose learners to the content-based generalizations needed to solve problems in a target domain at the outset of the learning process. He distinguished six steps in learning activity based on the use of models as learning tools. These steps are realized by means of the different structures of the instructional tasks. At the outset of the process, the entities and relations that constitute the content of teaching are clarified and modeled. Subsequently, new problems and tasks are generated based on the created model. The final steps in the process concern the control of the learner’s own learning actions and the evaluation of the sphere of the application of the model.

Galperin delineated the organization of learners’ exposures to the diverse variations of the target objects or problem situations, those related to the actions being formed, as the third sub-system of his formation theory. This sub-system emphasizes the significance of a wide selection of educational materials to which a learner is exposed during the learning process. Thus, for instance, the software developed by Porshnev (Oboukhova et al., 2002) for teaching French is endowed with a large selection of tasks covering the most important variations of contexts in which the learner can apply the grammatical constructions being learned.

In realizing the fourth sub-system of Galperin’s formation theory, internalization the target action at the beginning occurs in completely external and materialized form. The action being learned is separated from its material support and modeled and reflected in an instance of overt speech. This entails what Haenen (2001) called “communicated thinking”, explicating the structure of the actions in a way that it is understandable to others. In the final phases of the teaching procedure, the learner is encouraged to execute the actions by reflecting on them in the covert speech preceding the transformation of the actions to be executed completely in the mental plane.

In Western research on learning and development, the influence of the instructional approach developed by Davydov is found particularly in the works of Engeström (1987; Cole & Engeström, 2006), Hedegaard (1990) and Lompscher (1999). Following Davydov’s model of developmental teaching, Hedegaard (1990; 2002) developed an
approach called ‘double move of instruction’. In this approach, the teacher organizes the instruction on the basis of general laws. The instruction moves from concrete examples and the learners’ daily life conceptualizations to the general modeling of target phenomena. The learner’s activities are thus organized as guided investigations. Through working with the central conceptual relations and procedures that characterize the subject area, he or she acquires the scientific concepts of the subject.

Galperin’s works have also motivated pedagogical solutions developed by a number of Western pedagogical researchers and designers (Edwards, 1995; Haenen, 2001; Stolk et al., 2009; Terlouw 1993; Häyrynen & Hautamäki, 1973). In higher education, instructional practices, based on the use of orienting charts and Galperin’s notion of orienting basis have been implemented in the fields of medical, technical and teacher training (Edwards, 1995; Reshetova, 2004; 2006; Stolk et al., 2009).

Galperin’s theory of step-by-step formation of mental action and concepts, his distinction of the three types of instruction and finally, Davydov’s notion of ascending from abstract to concrete, together specify some concrete requirements for the implementation of cultural tools in pedagogical settings. These tools should represent both the structure of the actions being acquired and the essential properties and relations of the object or problem being acted on. In Studies I-III the conceptual meta-model under development was used to guide the participants in exploring how the abstractly modeled expository text-structures organize the knowledge about the concrete text-topics into a coherent content. Correspondingly, the participants’ concrete actions were guided to process expository text structures in various texts emphasizing the mutual relations of these structures. The aforementioned characteristics of the instructional approach implemented resonate with the features of the third type of instruction introduced by Galperin as well as the principle of ascending from abstract to concrete introduced by Davydov.

As a rule, the successful implementation of PSFMA has been reported in the teaching of arithmetic, grammar of foreign language, hand writing and other subjects amenable to complete instructional modeling (Amano, 1999; Galperin, 1992; Galperin & Kablynitskaia, 1974; Kabanova, 1976; Oboukhova, 1968; Oboukhova et al., 2002; Salmina. 1988; Talyzina, 1981). However, Arievich (2003), one of Galperin’s students, pointed out that, Galperin himself considered the method of action formation as a
research method and even took a skeptical stance towards the attempts to straightforwardly transfer this method into pedagogical settings. In what follows, the creation of the orienting basis is discussed in relation to separate components of human orientation and knowledge processing, which is considered as activity taking a shape in a more open-ended fashion than in PSFMA interventions.

2.3.3 Orienting activity as open-ended system

The present research in many respects capitalizes on Galperin’s theoretical views characterizing orienting activity as a more open-ended system than the process strictly regulated in traditional PSFMA interventions. According to Podolsky (2002), Galperin considered the structure and peculiarities of human orienting activity and psychological tools used in that activity as a main object of psychological research. Galperin pointed out that psychology should investigate a subject’s orientation towards various intellectual tasks focusing on how he or she represents them and identifying the means and tools the subject uses to productively address these tasks.

The conceptualization of orientation as specific activity that creates an image of a problem situation as its outcome opens up an opportunity to consider it as semiotically mediated and object-directed system. Galperin’s concepts of problem situation and its image in some respects parallel two concepts introduced in cognitive studies on problem solving (Friedriksen, 1984; Newell & Simon, 1972), a) task environment and its representation, b) problem space, constructed by a problem solver. However, Galperin (2002) posited that the aforementioned components of orientation, in turn, can assume the function and role of autonomic forms of activity. This notion allows the orientation towards a given problem environment to be considered as a long-standing process including sub-processes that differ in respect of their time frame and content.

In one of his lectures in the 1970s Galperin (2002) divided the orienting part of human action into motivational and operational sub-systems (Figure 1). The motivational sub-system of the orienting part should help a learner to link the target activity and its expected outcomes to his or her actual needs and thus afford the objectification of these needs. Galperin’s student and collaborator Talyzina (1983) emphasized the importance of arrangements that allow learners to objectify their knowledge-driven needs in educational settings. Such basic psychological needs as
perceived competency, autonomy and relatedness have over the past decades been considered as crucial factors influencing motivation in learning (Ryan & Deci, 2000).

Figure 1. Orientation as a system introduced by Galperin (according to Podolsky, 2002)

In the settings investigated in the present research, the participants’ pursued sense of competency was related to the expected alleviation of their difficulties in reading comprehension and their coming to know more about the processed text-topics (Studies I-III), and to the challenges of the participants’ current research work (Study IV). In Studies I-III, the intervener also put particular efforts into giving encouraging feedback to the participants about their developing competency during the interventions.

The participants’ perceived autonomy was supported by providing them with opportunities to make their own choices in the investigated settings. In Study IV the participants could choose the elements of the modeling language that they used and put efforts on orienting particularly towards those research methods, techniques and related issues that fell within the scope of their work-driven interests. In Studies I-III, the participants were encouraged to search for the text-topics that they found interesting, they could also process the texts immediately related to their school-assigneements. The character and content of the texts processed thus were not restricted to those selected in advance by the intervener; this distinguishes the interventions investigated in Studies I-
III from the traditional PSFMA procedures. The participants’ perceived relatedness in the investigated settings was reinforced by the interactional character of these settings, a topic that is discussed in more detail in the following section.

The further specification of the operational sub-system of human orientation sheds light on the representational functions that Galperin attributed to orientation as activity. This specification was also operationalized in designing various forms of OBA for educational settings (Reshetova, 2004; 2006). In the first half of the 1970s Galperin (2002; 1970; Padolsky, 2002) pointed out, in his lectures and presentations, that at least four components or dimensions can be distinguished in the operational sub-system of orientation (Figure 1). The first accounts for the creation of the overall image of the characteristics and elements of the problem situation related to the actions lying ahead. Galperin related the second component to the evaluation of the functional significance of separate elements of problem situation, and the third for the creation of the plan for the further actions. The fourth component, according to him, accounts for monitoring and correction. Later in the 1970s Galperin (1976) abstained from outlining distinct sub-systems of orientation and more cursorily distinguished such elements of orienting activity as motivation and various concepts and actions in the plane of images.

According to Galperin (2002; Reshetova, 2004), the so-called exploratory component of an orienting basis of action (OBA) should serve the organization of specific exploratory actions that facilitate the creation of a problem representation. These actions allow a learner to analyze and establish various functional features and relations of the object or problem situation that are essential for the target activity of the learning process. The learner’s exploratory actions can adhere to empirical as well as to general or domain specific-scientific methods. The planning component of OBA, in turn, should reflect the goal, key properties and phases of the actions being acquired, the key characteristics of their result as well as the tools and means needed in executing these actions. Finally the monitoring and evaluative component of OBA serves the function of keeping track of the actual realization of the activity.

Reshetova (2004), like Galperin pointed out that developing activity which lacks an established internal regulator cannot be properly shaped with a ready-made orienting basis. By contrast, OBA should be constructed by a learner in the learning process. Similarly, Dutch researcher Terlouw (1993) pointed out that in complex tasks which
include heuristic components learners should be provided with a preliminary orienting basis that contributes to the advancement of the learner’s orienting activity. Reshetova (2004) implemented the principles of system analysis as operational thinking schema (OTS) with students in higher education. The students in the aforementioned pedagogical settings were guided to analyze, by means of this schema, the subjects of the curriculum and the way the conceptual apparatus of a specific subject categorizes its target object or phenomenon as a system. For instance, exploring the subjects (domains of their studies) as systems the students analyzed the characteristic of their structure, the elements of the subjects, their properties as well as the structural, functional and genetic connections between the elements.

The diverse components of the operational sub-system of orientation can be seen to be closely related to the processing of various types of knowledge, such as conceptual, declarative, situational, procedural, strategic and planning knowledge (Anderson & Kratwohl, 2001; deJong et al., 1996; Pickard, 2007; Shavelson et al., 2005; Star, 2006; VanLehn & Brown, 1980). Conceptual and declarative knowledge refer to the facts, definitions, descriptions and principles that apply within a certain domain (Anderson & Kratwohl, 2001; deJong & Ferguson-Hessler, 1996; Jonassen, 1997; Shavelson et al., 2005). Anderson, and Kratwohl (2001) distinguished three subtypes of conceptual knowledge a) knowledge of classifications and categories, b) knowledge of principles and generalizations and c) knowledge of theories, models and structures. According to these authors, students have acquired conceptual knowledge when they can explain concepts in some domain in their own words and transfer information to new situations. Situational knowledge, according to de Jong, and Ferguson-Hessler (1996), is knowledge about situations as they typically appear in a particular domain, for instance knowledge about the elements usually inherent in domain-specific problems regardless of, whether and how they are explicated in a problem statement.

Of particular interest, from the perspective of the explorative component of orientation, is how learners apply domain-specific concepts and principles to analyze the elements of some problem situation or case. In addition, this perspective emphasizes the role of the process of the instructor’s compiling domain specific concepts, principles and models together with learners to create the orienting bases for approaching domain-specific problems. In the present research, the focus of the externalization of the
participants’ orientation and the related use of cultural tools was initially put on the schematization of the exploratory component of the operational sub-system of orientation. In Studies I-III, the intervener promoted development of exploratory component of orienting basis of action, the exploration of various frequent expository text-structures and their function as specific conceptual knowledge by means of external operational thinking schema. In Study IV the specific elements of the modeling language were meant to support the process of creating an overall image of the elements found in the problem environment, of considering various paradigms in the field of qualitative research as domain-specific conceptual knowledge. The elements of modeling language were also designed to be used in the reflections on the characteristics and philosophical backgrounds of research paradigms as conceptual knowledge included in the orienting basis.

According to Anderson and Kratwohl (2001), procedural knowledge includes the knowledge of subject-specific skills and algorithms, techniques, methods and criteria for determining, when to use appropriate procedures. Some authors have distinguished specific strategic knowledge from procedural knowledge linking the former to knowing of when, where and how apply knowledge, applying domain-specific heuristics and organizing problem-solving into a step-wise sequential process (deJong & Ferguson-Hessler, 1996; Shavelson et al., 2005). According to Van Lehn and Brown (1980; Star, 2005), procedures can be represented at an abstract level in the form of planning knowledge that reflects the sequential order of the steps included in a procedure, their goals as well as sub-goals. In addition, planning knowledge also reflects the environment or type of situation in which the procedure is used. Externalized scripts can be also used as supplementary procedural knowledge (Weinberger, 2011) to explicate procedures and their step-wise structure in the target domain of learning. Planning knowledge representing procedural knowledge can be seen to be congruent with Galperin’s specification of the character and function of the planning component of the operative sub-system of orientation.

In Studies I-III the planning component of orientation and related planning knowledge were mainly processed in the instructional discussions and guidance on the concrete actions in text-processing. These reflections captured, for instance, such actions as preliminary eying, looking for subtopics and generating questions. However
the last versions of the meta-model contained some elements directly related to concrete actions in text processing, for instance generic questions suggesting items to which one should pay attention in processing these structures. The component of orientation entailing monitoring and correction was realized in Studies II and III by using the meta-model in checking over possibly relevant elements of the model to reflect on a text content after the participants had first read this content and reflected on it aloud without the model. In Study IV, the specific elements of the modeling language were meant to afford the modeling of researcher’s actions in using qualitative and mixed methods for their own research.

Galperin’s account of the analytic and exploratory movements of learners mediated by operational thinking schemas addresses the process of the construction of new mental images rather than the change of pre-existing schemas addressed in the oldest versions of Schema theory (Bransford, 1983; Nassaji, 2002). Schema theory itself has been drastically evolved over the last decades towards conceiving schemas as flexible frameworks for generating organizational structures in particular task contexts (Kintsch, 1988; 1998; Whitney et al., 1995). Such theories as van Dijk’s and Kintsch’s (1983) Construction-Interaction model and Gernsbacher’s, (1990; 1997) Structure Building Framework consider reading comprehension as the process of reader-driven creation of knowledge structures. Galperin’s notion of operational thinking schema emphasizes the external modeling of the most significant entities and relations in the target domain of learning in a way that leads learners to employ them in their exploratory actions and generate new organizational structures. In addition, the conceptual distinction between the exploratory and planning component of the externalized orienting basis of action emphasizes the integrated modeling of concept-based understanding and practice-based competence regarded as important in expert training (Kinchin & Cabot, 2010). In what follows these processes are discussed from the perspective of the interactional contexts of the present research.

### 2.3.4 Orienting activity as interactive process

In the present research, the participants’ orienting actions were guided in an interactional context. The past two decades have seen attempts to explore the ways to integrate the cognitive and interactional approaches in the field of learning research
The Galperinian notion of orienting activity can be seen to provide a conceptual framework for the externalization of various cognitive processes that conventional cognitive approaches have considered as solely intra-mental. This applies, if orienting activity is approached a) as an interactive process mediated by cultural tools and b) as a process that is influenced by interacting subjects’ own agency in the use of cultural tools.

As Gauvain (2001) pointed out, the implementation of cultural tools in the guidance provided by an instructor or a more experienced partner appears in two social forms; in the provision of the tools themselves and in the interactional exchanges addressing the use of the tools. In using cultural tools together with an adult, a child lets the former know about his or her understanding and interests regarding the tool and directs the adult’s actions. In a similar vein, Cole (1996) and his colleagues concluded that various cognitive tasks that are used to direct children’s learning activities and based on cultural mediums function as resources for coordinated actions and as means of negotiating a common interpretation of the situation. Cole emphasized the inter-subjective use of a cultural medium in guiding children’s’ reading behavior and in promoting separate sub-processes of the act of reading.

The understanding of cultural tools based on the distinction between orienting-exploratory and executive components of action and on the conceptualization of orienting activity highlights the role of culturally evolved models and criteria in orienting learners towards cognitive tasks and problems. Consequently, these models and criteria can function as semiotic resources by means of which various cognitive tasks are reflected on in an instructional discourse together with learners to promote their “communicated thinking”.

The mediatory role of various schemas and models that reflect the target content of learning cannot be fully accounted by considering them from the perspective of conventional cognitive approaches as the properties of individual cognitive systems. Van de Sande and Greeno (2012) introduced an alternative approach to these conventional frameworks by accounting conversation as a cognitive system that processes and constructs information. Greeno (1998; 2006; Greeno, van de Sande, 2007) reinterpreted schemas, propositional networks, strategies and other cognitively
approached concepts, they characterized them in terms of informational contents of interaction and and processes of constructing common ground in activity systems. For this purpose Greeno, van de Sande (2007) introduced the concept of *perspectival understanding*. This concept specifies the functioning of a distributed cognition system and emphasizes the informational content that it processes.

Greeno and van de Sande defined a perspectival understanding as a cognitive arrangement of entities and some of their properties, organized in relation to each other with a point of view. A distinctive characteristic of perspectival understanding is that it is the outcome of an organizing discursive process. Van de Sande and Greeno (2012) also introduced the concept of *conceptual framing* referring to the way, participants organize information in the situation they are discussing and in the context of a problem they are working on. In the present research this process is considered as a specific form of joint, orienting activity, based on Galperin’s account of human orientation.

Greeno, and van de Sande (2007) specified the concept of schema as a previously learned pattern that organizes some aspect of a situation. According to them, a person or group can apply specific schemas in a situation. However constructing a perspectival understanding requires also an individual or group to construct relations that are not justified by familiar disciplinary procedures that the recognized schemas are based on. Learners’ capability of constructing perspectival understanding can be enhanced by attuning them to various domain-specific aspects of discourses relevant to the situations, ones for which they do not have sufficient schemas.

The acquisition of various modes of processing expository texts constituted the object of the participants’ learning activity in Studies I-III. In these studies the elements of the meta-model were used to attune the participants to the common expository text structures that convey the essential information to be relied on in constructing the perspectival understanding of text-topics. The elements were also systematically implemented in the instructional discourse as conceptual mediators to be used to organize separate sections of the processed texts in coherent relation to each other. Studies I-III yielded findings on how the participants incorporated various aspects of the instructional discursive process as means for their own orienting actions in processing new text topics.
Orienting towards the field of qualitative and mixed methods and related practices constituted the object of the participants’ learning activity in Study IV. In Study IV, the modified elements of the meta-model, compiled as the codes of a digital modeling language, mediated the externalization of the participants’ perspectival understanding of qualitative and mixed methods in concept maps. The created concept maps were intended to serve as orienting bases for the employment of these methods in the participants’ own studies. The codes of modeling language performed the function of a preliminary orienting basis meant to attune the participants to some aspects of domain-specific discourse, for instance, the philosophical underpinnings of research strategies and trustworthiness issues.

Study IV focused on how the participants constructed perspectival understanding by creating concept maps with the elements of the modeling language as well as by discussing on the created maps during the seminar. The investigated instructional, discursive process thus included both the creation of concept maps and the discussion on the created maps. The study yielded findings on how the participants used the modified elements of the meta-model to organize domain-specific conceptual entities in creating concept maps as orienting bases for the use of qualitative and mixed methods. In addition the study shed light on how these orienting bases were subsequently implemented, in her guidance, by the teacher at the investigated setting.

The instructional approach developed and explored in the present research utilized various frequently used expository text structures as crystallized templates that represent the culturally established ways of organizing knowledge in expository texts. In what follows, there is a discussion in more detail, of the functioning of expository text structures and their utilization as cultural tools in the present research.

2.4 Orienting activity studied in the present research

2.4.1 Conceptualized expository text structures as coherence-supporting cultural tools

In the present research, a set of modeled expository text-structures was used to promote the participants’ orienting actions. Expository text is the most common formalism that we use to capture and represent what we know, and it also constrains our representations (Jonassen- & Marra, 1994). Expository texts have been considered to
include various knowledge structuring affordances that a learner can implement both to process these texts and to mediate his or her own knowledge organizing efforts (Meyer, 2010 et al.; Wertsch, 1998). Coherence serves as the basic organizing principle of expository texts in general (Graesser et al., 2003; McKeown et al., 1992). Recognizing this organizing principle and the linguistic means that realize it in various texts allows a learner to anticipate various affordances he or she will encounter in processing these texts (Graesser, McNamara & Louwerse, 2003; Meyer, 2010).

Specific signaling words (Meyer & Poon, 2001) or other linguistic markers, including phrases and sentences (Graesser et al., 2003), signal the presence of specific connections between the ideas presented in expository texts. A procedural discourse is a specific example of the use of expository text structures with a guiding purpose to explicate various actions, desired and undesired states of the system within which the actions are undertaken, as well as the responses of the system (Farkas 1999; Jansen & Steehouder, 1996). Expository text structures are not limited to texts but are rhetorical structures also used in spoken discourse (Williams, 2007).

Whereas various forms of micro- and macro-structures frequently used in presenting information in expository text may function as generic mediatory means, the specific content of these structures can also assume this function. Wertsch (1998; 2008) characterized the historical narrative, often shaped by public expository text with historical topics, as a cultural tool. It offers schematic narrative templates that learners can use to mediate their actions in reproducing accounts of various historical events. Another example of the use of domain-specific expository text-structures in an instructional context is the implementation of text structures with domain-specific conceptualizations that direct students’ elaborations towards specific aspects of the problem (e.g., a designing task) worked on (Kosonen et al., 2012; McNeil & Krajcik, 2009; Muukkonen-Van der Meer, 2011).

Various linguistic markers and coherence relations that are common in expository texts have motivated instructional designers to create models to help readers to recognize and implement these markers and relations. Meyer and her colleagues developed a specific instructional technique called Text Structure Training that distinguishes five, basic, organizational structures of texts, Description, Sequence, Causation, Problem/solution, Comparison and Listing (Meyer, 2010; Meyer & Poon,
Structure Strategy Training-interventions provide learners with the examples of various linguistic expressions used in texts to organize and signal the aforementioned structures. Another approach used in general to scaffold cognitive processing, (also text processing), known as the TCU knowledge mapping system is based on knowledge prototypes (in the form of explicit node-link labels) which are used to guide learners to create knowledge maps (Lambiotte et al., 1989; O'Donell et al., 2002). McCagg and Dansereau (1991) distinguished three main categories of links that can be implemented in knowledge mapping, Dynamic (“influences”, “Next”, “Leads to”), Static (“Type”, “Part”, Characteristic”) and Elaborative (“Example”, “Analogy”). The research reports on the use of knowledge mapping in processing expository texts indicate that it can facilitate the elaboration on macro-level ideas in texts.

The present research is based on the notion that conceptualized; widely used expository text structures can a) function as societally established and crystallized templates for organizing knowledge coherently in an elaborate, also joint, orienting activity. These structures, also, b) serve as sign-creating anchors (Engeström, R, 2009) used to organize “communicated thinking” (Haenen, 2001) in jointly processing expository texts and other complex conceptual objects. In the original studies of the thesis a set of modeled expository text-structures in a generic and more contextualized form was used to promote the participants’ orienting actions. The use of the elements of the meta-model as well as its revisions was explored. The first versions of the meta-model mainly listed various expository text-structures and clarified their meanings, these versions constituted the exploratory component of the orienting basis of action (Galperin, 2002; Reshetova, 2004). The meta-model was initially designed in a touchable form by means of tactile materials and Braille typing (Figure 2).
Figure 2. Orientation bases with the elements typed in Braille (top) and. the meaning of the elements typed in Braille (bottom)

The first component of the operational sub-system of orientation (Galperin, 2002), the creation of the overall image of the characteristics and elements of the situation was related to the participant’s orientation towards frequently found expository text structures encountered in various texts. This element was mainly supported by the meta-model that was used to conceptually distinguish diverse expository text structures. The second dimension of operational orientation, the evaluation of the functional significance of separate elements of the problem situation (Galperin, 2002) was realized in the participants’ reflecting on the meaning of various expository text structures in discussing with the intervener and revising the corresponding elements of the meta-model. These revisions specified the functional significance of the expository text structures by presenting generic questions illustrating what kind of information they
usually carry and also by presenting typical linguistic expressions signaling the presence of diverse structures in texts. The specific meanings of these structures were also reflected on in concrete texts. In this regard, the meaning of separate text structures encountered was the subject of reflection in relation to the main topics of the texts processed by means of the elements of the meta-model.

The first versions of the meta-model mainly listed various common expository text-structures and clarified their meanings. The digitalized meta-model used was also incrementally supplemented with the examples of linguistic expressions used to signal the presence of the structures that the participants were prone to ignore or misinterpret. The meta-model as the externalized schema of orienting basis of action, thus, can be seen, to reflect conceptual knowledge (Anderson & Kratwohl, 2001; deJong & Ferguson-Hessler, 1996; Jonassen, 2005; Shavelson, Ruiz-Primo & Wiley, 2005) that in this context is knowledge about expository text structures their meanings and related linguistic expressions. In addition, the last versions of the meta-model contained some planning knowledge (Star, 2005) directly related to concrete actions in text processing, for instance generic questions suggesting to what one should pay attention in processing these structures (Figure 3).

![Figure 3. Meta-model converted in a digital form](image)

The meta-model initially developed with the blind participants in the present research was subsequently implemented as a heuristic framework to design a digitalized modeling language in a specific domain. In the next section the implementation of the elements of the meta-model in this context is presented in more detail. The orienting
activity investigated is portrayed as a cognitively distributed process that is given various degrees of freedom in scaffolding. Subsequently, the aim of the research is presented in more detail.

**2.4.2 Scaffolded and distributed orienting activity as the object of the present research**

*Action* was defined as the unit of the analysis of the development of human activity in in Leontiev’s and Rubinstein’s writings in the 1940s (Abulhanova-Slavskaja & Brushlinsky, 2005; Talyzina, 1983; Zaporozhets & Elkonin, 1983). In the present research the participants’ external actions and their outcomes in using the elements of the developed meta-model served as the unit of analysis. A single action was conceived as a productive process wherein the subject is connected to the object with culturally constituted (tools, signs) meditational means (R. Engeström, 1999). In this regard, both the participants’ separate actions and the reflectively used elements of the model were considered to perform a mediatory function in processing the conceptual objects (Expository texts and their topics in Studies I-III, qualitative and mixed methods in Study IV).

Cole (1996) and Hedegaard (1990; 2002) approached the operationalization of the zone of proximal development from the perspective of learners’ actions. Framing an instructional framework called Question-Asking-Reading –instruction (QAR), Cole (1996) attributed to this framework a function of the ZPD. QAR -interventions engaged struggling readers in diverse roles in executing separate elements of reading action (for instance asking a question about the main topic of passage or the words that are hard to understand). These interventions thus helped the groups to jointly achieve a level of performance that was beyond an individual participant’s reach. Hedegaard regarded spontaneous and subject-matter concepts as creating the lower and upper levels of learners’ zone of proximal development within which a teacher directs learners’ actions in developmentally appropriate manner. The character of the entities and their relations represented in the teacher’s model of the target phenomenon are uncovered by the learners in their exploratory activity that is directed to the phenomenon and its diverse variations.
The settings that were investigated in the present research opened up an opportunity to consider the ZPD in relation to two diverse types of arrangements affecting the participants’ actions. The first type of arrangement was based on the instructor’s use of the elements of the model or other tools in directly structuring the participants’ actions. The second type of arrangement allowed the participants to make choices in respect of which elements of the model they used and in respect of how they used these elements. The participants’ actions, in turn, were expected to exert influence on how the instructor perceived and reflected on the zone of the proximal development of these actions and the participants’ understanding of the issues discussed.

A framework that approaches the ZPD from the perspective of both developing person’s constrained and suggested potential actions is provided by the zone theory of Valsiner (1998). This theory specifies the zone of proximal development within a learner-environment-system. Besides various developmental contexts it has also been applied to the analysis of specific educational settings and learning contexts (Blanton, Westbrook, Carter, 2005; Goos, 2010). The zone theory conceptualizes semiotic mediation as regulation based on the partitioning of the field of possibilities in the environment.

The first concept of Valsiner’s (1998) zone theory, \textit{zone of free movement} (ZFM), refers to a set of constraints that structure a) a child’s or learner’s access to different areas of environment, b) availability of objects in the accessed areas and c) ways of acting with these objects. As an outcome of this set of constraints a child or learner comes to create a ZFM in his or her own thinking and feeling. The constraining function of ZFM can be seen to parallel the functions of the “reduction in degrees of learners’ freedom” and “direction maintenance” that Wood et al. (1976) considered as the fundamental function of a tutor in scaffolding. Direction maintenance was described by Wood et al. (1976) as a tutor’s role of keeping a learner in pursuit of a particular objective. For instance, in using visualization software in a pedagogical setting the zone of free movement can be restricted by narrowing visualization options to those relevant to the learners’ current goals (Reiser, 2004).

Valsiner specified the notion of the zone of promoted actions (ZPA) as a sub-zone of (ZFM). The ZPA provides structure to the ZFM by guiding a person’s actions, feeling and thinking towards some of its parts, however not obliging him or her to proceed
accordingly. ZPA, in some respects, is congruent with the function of a tutor in scaffolding that Wood et al. (1976) labeled “marking critical features”. The ZPA provides some suggestions as orientation devices that can be neglected by the person. Thus, for instance in an educational setting ZPA can be realized by using software tools that help students to see something as requiring attention and decision making that they might otherwise overlook (Reiser, 2004).

Valsiner also included in the zone theory also the concept of zone of proximal development borrowed from Vygotsky, however he attributed to it a specific meaning that stems from the meanings of ZFM and ZPA. Consequently ZPD in this conceptual framework refers to the immediate possible next states of the person-environment system that is constrained by the current ZFM and ZPA in a given situation at the given time. This conceptualization of ZPD can be seen to resonate with the gradual movement towards more complex tasks as the aspect of a tutor’s function, direction maintenance described by Wood et al. (1976).

Valsiner’s zone theory has been implemented in analyzing classroom settings that continually require teachers to make decisions about the students’ actions being promoted. In this context ZFM— ZPA-complex is considered as a product of teacher’s instructional choices (Blanton et al., 2005). In the present research, the categories of ZFM, ZPA and ZPD were implemented in exploring how the use of the elements of the developed meta-model afforded the participants actions in processing various conceptual objects and how these actions affected the instructor’s guidance. The elements of the meta-model developed were mainly implemented in the participants’ zone of free movement (ZFM) in Studies I-III. In these studies, the participants were prompted to explore various expository texts and their topics and select the path of their actions in processing these texts by using the elements of the model. In the settings, the ZPD was considered as the intervener’s (Studies I-III) and the teacher’s (Study IV) interpretations of the possible next states of the interaction between the participants and the conceptual objects being processed as well as the elements of the meta-model.

In Study IV the contextually modified elements of the meta-model compiled as the codes of the digitalized modeling language (see Table 2) were implemented within the participants’ zone of promoted actions (ZPA). The codes of the modeling language functioned as suggestions on what to consider in the participants conceptual
explorations and practice related elaborations. The suggestions on conceptual explorations corresponded to the exploratory component and the suggestions on practice related elaborations to the planning component (Galperin, 2002; Reshetova, 2004) of a preliminary orienting basis (Terleuw, 1993). They marked some critical conceptual entities and relations in the virtual environment in which the participants were intended to work on concept maps regarding qualitative and mixed methods.

The codes meant to be used in conceptual explorations drew the participants’ attention to the need to distinguish diverse research strategies and their philosophical backgrounds as conceptual knowledge included in orienting bases. The codes meant for practice-related elaborations brought into salience the issues related to a researcher’s actions in using qualitative and mixed methods for the participants’ own research and the reflections constituting the planning knowledge (Star, 2005) included in the orienting bases. The participants were not systematically required to check these suggestions while they selected their paths of action. Instead, the suggestions in the form of language codes were available in the digital environment to be used according to the participants’ preferences.

| Table 2. Elements of modeling language in Study IV |
|----------------|---------------------------------|-----------------|
| Type | Corresponding section in the meta-model | Element, main code, guiding exemplary expressions | Symbol |
| Codes for conceptual explorations | I Definition | Link, “Defining”, “For defining” | Yellow arrow |
| | III Purpose | Example: “The method x is...” | Yellow arrow |
| | | Link, “Function”, “For the description of purpose” | |
| | | Example: “The method x is meant for...” | |
| | VI Properties | Link, “Feature”, “For the description of feature” | Green arrow |
| | | Example: “A characteristic feature of the method x” | |
| | | Node, “Trustworthiness” | |
| V Examples | Link, “Type/example”, “For the grouping of various types” | Blue arrow |
| IX Forms of occurrence | Example: “There are such paradigms of qualitative research as...” | |
| II Causes | Link, “Affects”, “For the description of influences” | Orange arrow |
| | Example: “The research paradigm x is motivated by the philosophical framework y”, “z affects | |

Table 2. Elements of modeling language in Study IV
The elements of the meta-model in the present research in many respects assumed the function that a framework of distributed cognition attributes to external artifacts (Belland 2011; Hutchins, 2005; Jonassen, 2005; Kirch 2010; Zhang, 1997; Zhang & Norman, 1994). Unlike the conventional cognitive theories, the distributed cognition framework posits that coherently organized knowledge does not necessarily have to be fully internalized in the form of mental representations. Instead, it can be embedded in the system constituted by the people working on and using knowledge and the external artifacts being created and modified in this work as material carriers of knowledge (Hutchins, 2005; Jonassen, 2005; Kirch, 2010; Zhang & Norman, 1994). Consequently the scaffolds can be used as the components of distributed cognition system to share with learners the cognitive load posed by the tasks of their learning process (Belland, 2011; Pea, 2004).

Belland (2011) pointed out that to optimally support learners to assume responsibility from a distributed cognition system, they should be provided with an opportunity to
make choices and select action paths in interacting with scaffolds. Interacting with scaffolds should, instead of supporting algorithmic processes, help learners to see the problems that they work on from multiple perspectives and encourage reflection. Scaffolds of this kind, for instance question prompts, have been found to lead students to produce better representations of their target problem compared to the representations created by students not using scaffolds (Gee, 2005). Scaffolding based on the use of external instructional artifacts can be seen to result in the creation of newly organized knowledge that guides students in their approach to new problem situations in a target area (Salomon et al., 1991).

**Original studies I-III**  **Original study V**

Figure 4. The elements of the meta-model used as scaffolds in the original studies

In the present research the elements of the developed meta-model were used as scaffolds to promote the participants’ orienting actions organizing the knowledge related to the conceptual objects (expository texts, the field of qualitative and mixed methods, Figure 4) that they processed. The regular use of various versions of the external meta-model as instructional artifacts in the original studies opened up an opportunity to collect and analyze data about distributed orienting activity. As within research settings based on Distributed cognition framework, the data concerning the use of the elements of the meta-model and its analysis made it possible to identify related representational states and processes acting on them (Halverson, 2002). However unlike
in Distributed cognition framework, the present research explores the distribution of cognitive processes between the participants and material artifacts within the object directed activity that is realized by the participants’ conscious actions. Consequently, the research emphasizes the role of object, the participants’ understanding of expository text structures in Studies I—III and in Study IV the participants’ understanding of the field of qualitative and mixed methods as the object of their learning activity. Various representational states and processes acting on them were explored in respect of how they reflected the aforementioned objects.

2.4.3 Aim of the research and research questions

While Studies I-IV had their own aims and specific research questions they served the more general goal of the present research. It aimed at exploring the facilitatory function of the use of the elements of the meta-model based on expository text-structures as cultural tools in promoting the participants’ orientation towards multifaceted conceptual phenomena while accounting for their individual needs and interests.

Valsiner’s zone theory was used to operationalize, in the settings investigated, the guidance of learners’ orientation activity and its dimensions distinguished by Galperin. Since the degrees of freedom of the participants’ actions with the elements of the meta-model varied both across and within the original studies the central concepts of Valsiner’s zone theory were found to be a worthwhile framework to represent and operationalize these variations. Consequently the research focused on how the meta-model functioned a) in the participants’ zone free movement (ZFM), b) in their zone of promoted actions (ZPA) and c) in their role as mediators of the instructors’ actions in outlining the zone of the proximal development (ZPD) of participants’ actions.

The concept of the zone of proximal development in the present study refers to the instructor’s guidance that explicates the next recommended states of the interaction a) between the participants and the elements of the meta-model and b) between the participants and the conceptual objects being processed. The concept of the ZPD, thus, was also borrowed from Valsiner’s zone theory in which it is related to the immediate possible next states of the person-environment system constrained by the current ZFM and ZPA in a given situation at the given time. Based on the aforementioned meanings of ZPA and ZFM the following research questions were posed:
1. What are the actions (their kind) that were afforded and promoted by the elements of the meta-model while they were being used a) to direct the participants’ orienting actions (in the zone of free movement, ZFM) and b) to provide suggestions about what to address with orienting actions (in the zone of promoted actions, ZPA)?

2. How did the participants’ responses and conceptualizations in the ZFM and ZPA, while participants used the elements of the meta-model mediate the instructor’s guidance in the zone of proximal development of the participants’ orientation actions, while they were processing the conceptual objects?
3 Empirical studies

The present research explored the target phenomenon, promotion of learners’ orienting actions with cultural tools in authentic learning contexts. The thesis consists of four different types of case-study which were analyzed mainly by qualitative research strategies. The following sections describe the research strategies and techniques used in more detail and also critically reflect on the related trustworthiness issues and specific methodological challenges.

3.1 Research strategy

The present research aimed at shedding light on a) what kind of orienting actions by the participants were facilitated and supported by the meta-model based on various expository text structures and b) how this mediatory function of the model was realized in the instructor’s guidance in the investigated settings. The meta-model itself was developed and tested during the studies. This character of the studies excluded the possibility of implementing the conventional methods of intervention research in which the intervention investigated is conceived as a strictly planned and controlled independent variable and the outcome variables are measured systematically according to predefined criteria (Kratochwill et al., 2013). The selection and implementation of research methods in the studies mainly served the analysis of the enacted use of the elements of the meta-model and its influence, therefore qualitative research was implemented.

Qualitative research is a systematic approach to understanding qualities, or the essential nature, of a phenomenon within a particular context (Brantlinger, et al., 2005). In the present research the use of the meta-model constituted the phenomenon investigated. A qualitative research approach made it possible to explore this phenomenon in terms of the meanings that the participants constructed for it (see Denzin & Lincoln, 2005; Merriam, 2009). The elements of the meta-model were reflectively used and interpreted by the participants and the meanings that the participants attributed to these elements constituted the crucial part of a data collected.
3.1.1 Case-study as the main research strategy in the study

A specific methodical challenge of the present research was posed by the fact that the researcher performed the function of an instructor in Studies I-III. He thus had to focus on planning the interventional sessions during the interventional processes. The interaction between the participants and the elements of the developed meta-model assumed various unpredicted forms and characteristics although the interaction was regulated by the instructor. The exploratory case study was found as the most suitable research strategy since according to Yin (2003) it allows a) fieldwork and data collection to be undertaken prior to definition of the research questions and hypotheses and b) research to be implemented in a flexible way in exploring the characteristics and relations of data that could not be anticipated at the outset of a study. Case studies, in general, typically aim to expand the understanding of various cultural systems of action. A system of action rather than an individual or group of individuals constitutes the unit of analysis in these studies (Feagin et al., 1990; Tellis, 1997).

Study I, besides having the form of an exploratory case study, in many respects also assumed characteristics that Stake (1995; 2005) attributes to the type of case study that he calls intrinsic. In an intrinsic case study, a researcher examines the case for its own sake and for the better understanding of the peculiarities of the case. Study I thus explored whether the developed meta-model helped the participant to process expository texts and how the intervener had to modify the meta-model to make it suitable to the unique case. These general questions served the further examination of the use of the elements of the meta-model in various instructional contexts. The participant’s recorded, unique and individual perceptions and interpretations in conjunction with the observations about her school performance constituted the data of Study I.

The setting of Studies II-IV in many respects converges both with Stakes’ (1995; 2005) characterization of instrumental case study and Yin’s definition of the exploratory case study. In an instrumental case study the researcher selects a small group of subjects in order to examine a certain pattern of behavior. Consequently, the choice of a case is made to advance the understanding of an issue external to a particular case. As Hamilton (2011) pointed out, instrumental case-study is the most frequently used model in education. In studies II-IV the focus was put on the exploration of the functioning of
the elements of meta-model in diverse instructional settings in promoting the specific scope of the participants’ knowledge-organizing orienting actions. Consequently, the main subject of these studies had these components: the participants’, the intervener’s (Studies I-III) and the teacher’s (Study IV) behavior related to the use of the elements of the meta-model and to the outcomes of the enacted use of the elements.

As a whole the present research is multiple-case study (Yin, 2003) by its nature since it examined the enacted patterns of the use of the elements of the developed meta-model across the all four original studies. The theoretical framework presented in this introduction served as a descriptive theory, the theory was capitalized on in the analysis of these patterns and their influence on the participants’ and instructors’ actions.

The interventional design (instructional use of meta-model) in the present study was based on the basic principles of the method of double stimulation originally introduced by Vygotsky (1983; Cole & Engeström, 2006). In all four studies the participants were exposed to two clusters of stimuli. The first clusters of stimuli consisted of the conceptual objects that the participants were intended to work on (topics and expository structures of various texts and writing assignments in Studies I-III and concept maps on qualitative and mixed methods in Study IV). The second clusters of stimuli included the elements of the developed meta-model that were introduced to the participants as scaffolds to support their orienting actions and to be used in organizing these actions.

The method of double stimulation as an interventional mechanism was applied in conjunction with data collection and analysis that made it possible to capture the various ways of functioning of this mechanism. In this regard, various ways of using the elements of the meta-model and the outcomes of the implementation of these elements were the focus of data collection and analysis. A common feature between the all four studies is the specific characteristic of the unit of analysis put at the center of the research. It was constituted by the actions through which the participants were connected to the conceptual objects that they processed with cultural mediational means (Engeström, 1999). The elements of the investigated meta-model performed the function of these mediational means in the original studies.

The research strategies used in the studies yielded findings indicating how the elements of the meta-model mediated the participants’ elaborations on the conceptual objects, those at which their learning activity was targeted. The methods used in Studies
II-IV helped to shed light on how the use of the elements of the meta-model shaped the instructional discourse in the settings investigated. The research design of Studies II and III made possible to make comparisons between the processing of various conceptual objects with and without the elements of the conceptual model. This design also enabled one to explore possible changes of the participants’ orienting actions during the interventional processes and study the role of the elements of the meta-model used in these changes.

### 3.2 Contexts, settings, and participants

The studies of the present thesis explored the use of the meta-model developed in two diverse contexts, a) in promoting young blind learners orienting actions in processing expository texts b) in promoting university students orienting actions in learning to use qualitative and mixed research methods in their own research projects (Table 3).

<table>
<thead>
<tr>
<th>Study</th>
<th>Participants</th>
<th>Contexts of study</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Individual, blind female</td>
<td>The development and initial piloting of the meta-model in text-processing</td>
<td>6 F2F- sessions every 1-2 weeks</td>
</tr>
<tr>
<td>II</td>
<td>Individual, blind male</td>
<td>Exploring the use of the elements of the meta-model in guiding the participant’s question generation in text-processing.</td>
<td>20 F2F-sessions every 1-2 weeks</td>
</tr>
<tr>
<td>III</td>
<td>Individual, blind male</td>
<td>Exploring the use of the elements of the meta-model in promoting the participant’s structuring inter-actions with text-content</td>
<td>20 F2F-sessions held every 2-3 weeks</td>
</tr>
<tr>
<td>IV</td>
<td>Six doctoral students (three pairs)</td>
<td>Exploring the implementation of the contextually specified elements of the meta-model in supporting concept mapping in the use of qualitative and mixed methods</td>
<td>12 F2F-sessions weekly</td>
</tr>
</tbody>
</table>

The participants in Studies I-III were 3 blind teenagers (14-18 years old). They were struggling to cope with the increased information load in their daily learning settings. The participants were preterm born in the 24-26th week of pregnancy and the price of saving these children’s lives in an oxygen chamber was losing their eye sight permanently. Extremely premature birth has been found to be strongly associated with educational and vocational impairment in young adulthood (Lindström et al., 2007). Among extremely preterm children, cognitive and neurologic impairment is common at
school age. The increased prevalence of medical disabilities, learning difficulties, and behavioral and psychological problems among surviving preterm infants have raised concerns about these infants’ possible difficulties in coping with adult life (Moster et al., 2008). One study found that the parents of such young adults, formerly preterm, reported significantly more psychological problems for their sons and daughters in comparison to control subjects (Hack et al., 2004).

The settings investigated in Studies I-III were parts of the interventions in which the researcher developed and used the meta-model to enhance the participants’ text-processing strategies in reading for understanding. Study I was a pilot study and explored the preliminary designing and instructional functioning of the meta-model based on various expository text structures. The initial purpose of the study was to develop an orienting basis that takes the form of a conceptual meta-model and helps the participant to process expository texts. The objective of the instructional design at the outset of the process was thus exclusively rehabilitative. However the positive interventional outcome of the process led the researcher to retrospectively frame it as a case study to develop and evaluate the intervention procedure in his further studies. The study involved 6 intervention sessions, varying from 60 to 90 minutes in length. They were held at the participant’s home. The basic elements of the orienting basis were introduced and used to scaffold the participant’s reading process during these sessions.

Study II explored the use of the elements of the meta-model in guiding the participant’s question generation in processing expository texts. Study II was divided into two stages that differed in respect of the focus of data collection and analysis. During the first stage (9 interventional sessions) the initial version of the meta-model was implemented and modified by revising its guiding elements and integrating into it new elements that turned out to be useful during the sessions. The second stage of the study (11 sessions) focused on the usage of the modified meta-model in reflecting on the contents of new expository texts.

Study III focused on examining how the separate elements of the meta-model served as scaffolds that mediated the participant’s structure-building actions in processing text contents. 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 that
acquainted the participant with the use of the meta-model in elaborative questioning and 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 texts.

Study IV was conducted in a seminar of qualitative and mixed methods at the Institute of Behavioural Sciences, University of Helsinki. The teacher of the investigated seminar as well as four female and two male students participated in the study. These students were working on their doctoral thesis. The aim of the seminar was to offer students a practice-related setting which combined students’ own research work for their doctoral thesis, and the research practices of a professional research community in general. Students conceptualized their developing understanding about qualitative and mixed methods by creating concept maps in pairs throughout the seminar. The work on concept maps was supported by the modeling-language based on the elements of the meta-model developed in Studies I-III. The creation of concept maps was investigated as a process of the creation of an orienting basis for the participants’ further research actions. In addition, Study IV explored how the orienting bases created by the students of the seminar and the used elements of modeling language mediated the teacher’s guidance to them.

### 3.3 Data collection

Data analyzed in the studies of the present thesis were collected from various sources using a variety of methods. The data sources were similar to the sources of the evidence typically used in case studies (Stake, 1995; Yin 1994). The data consists of video- and audio-recorded presentations, interventional sessions, physical as well as digital artifacts, and documents (Table 4).

<table>
<thead>
<tr>
<th>Study</th>
<th>Character of data</th>
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<tbody>
<tr>
<td>I</td>
<td></td>
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<tr>
<td></td>
<td>Touchable mind maps created during the intervention process</td>
</tr>
<tr>
<td></td>
<td>The participant’s orally presented audio-recorded interpretation describing the trial</td>
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<tr>
<td></td>
<td>Documents about the participant’s school performance during and after the intervention process.</td>
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<td>II</td>
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<td></td>
<td>Transcribed video-recordings of all sessions</td>
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<td></td>
<td>All the drafted versions of the meta-model and revisions made to them, related intervener’s reflective statements</td>
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<td></td>
<td>Transcribed guiding interactive episodes between the intervener and the participant</td>
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<td></td>
<td>Participant’s video-recorded and typed questions and reflections</td>
</tr>
</tbody>
</table>
III  
- Transcribed video-recordings of the sessions
- Participant’s (video-recorded) reflections and overt speech
- Intervener’s observation notes.

IV  
- The final versions of the students’ concept maps of each pair (3 maps)
- Video-recorded closing session of the seminar during which the students presented their maps and the teacher commented them.

3.3.1 Documents and physical artifacts
Data having a character of documents, or physical artifacts consisted of various material and digital forms of the developed meta-model (all studies) and the digital artifacts created by the participants (Studies III and IV). Material artifacts were particularly pronounced in Study I, during which the initial development and piloting of the meta-model took place. They included touchable mind maps that performed the function of an orienting basis during the intervention. In this study, documents were also available to the investigator on the participant’s school performance during and after the intervention process. In the other studies, the artifacts and documents were mainly digitalized and consisted of various forms and versions of the meta-model and its elements as well as the artifacts created by the participants.

3.3.2 Video- or audio-recorded sessions and presentations
Besides physical artifacts, the data that made it possible to track and observe the participants’ actions included the participants’ audio or video-recorded oral presentations and comments (Studies I and IV) and video-recorded sessions (20 sessions in Studies II and III).

One camcorder directed to the participants was used in Studies II-IV to record interventional sessions and presentations. In Study I, a MD-recorder was used to record the participant’s presentation. The participants’ oral presentations in Studies I and IV provided important data about their interpretations and intentions related to the use of the elements of the meta-model. Unlike the participant of Study I the participants of Study IV could in their presentations lean on the orienting bases that they had created during the investigated seminar. The recorded data were transcribed for further analysis.
3.4 Data analysis

In the present study qualitative analytical methods were used. Quantifying qualitative analysis (Chi, 1997) was used in exploring a) the instructional dialogue between the participants and instructors, b) the participants’ speech and c) the participants’ actions in using the elements of the model and the outcomes of these actions (Table 5). The analyses of the participants’ verbalizations and the content of their content maps (in Study IV) helped to extract the findings that helped provide answers to the first research question. Analysis of the data from instructional interactions as well as the revisions of the developed meta-model (particularly in Study II), in turn, provided findings that helped to answer the second research question. Besides qualitative analytical methods a non-parametrical statistical test was used in Study II. In addition some results of the study are based on the qualitative descriptions of separate elements of data having a unique character and thus not amenable to quantification.

Table 5. Summary of data and data analyses across the studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Data</th>
<th>Data analysis</th>
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<tbody>
<tr>
<td>I</td>
<td>Touchable mind maps created during the intervention process</td>
<td>Evaluation of the created touchable maps in respect of their suitability to the participant’s individual needs and capabilities</td>
</tr>
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<td></td>
<td>The participant’s orally presented audio-recorded interpretation describing the trial</td>
<td>Analysis of the participant’s orally presented interpretation of the interventional process in respect of the perceived usability and internalization of the elements of the meta-model</td>
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<tr>
<td></td>
<td>Observations about the participant’s school performance during and after the intervention process.</td>
<td>Supplementary analysis of the information about the participant’s school performance and learning activities at home for evaluating the usability of the meta-model</td>
</tr>
<tr>
<td>II</td>
<td>Transcribed video-recordings of all sessions</td>
<td>Qualitative analysis of guiding interactive episodes mediated by the meta-model, the participant’s question generation process, questions and other verbalizations and their development by means of analytical categories created during the organization of data into meaningful segments</td>
</tr>
<tr>
<td></td>
<td>All the drafted versions of the meta-model and revisions made to them, related intervener’s reflective statements</td>
<td>Evaluation of the usability of the revised versions of the meta-model</td>
</tr>
<tr>
<td></td>
<td>Transcribed guiding interactive episodes between the intervener and the participant</td>
<td>Statistical analysis of the external evaluators’ scores on the participant’s questions.</td>
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<td></td>
<td>Participant’s video-recorded and typed questions and reflections</td>
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<td></td>
<td>External evaluators’ scorings of the participant’s questions</td>
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<tr>
<td>III</td>
<td>Transcribed video-recordings of the sessions</td>
<td>Analysis of the participant’s responses to the intervener’s guiding actions during structuring text-processing activities,</td>
</tr>
<tr>
<td></td>
<td>Participant’s video-recorded reflections and overt speech</td>
<td>Analysis of the participant’s responses while using the conceptual model externally during these activities</td>
</tr>
<tr>
<td></td>
<td>Intervener’s observation notes.</td>
<td>Analysis of the participant’s spontaneous actions and</td>
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3.4.1 Methods of qualitative analysis

The focus of Study I was on the development and piloting of the meta-model implemented in the subsequent studies. Consequently data analysis focused on the evaluation of the quality of implementation of the developed meta-model. In Study I data were analyzed in a way that corresponds to Gall, Gall, and Borg’s (1999) description of reflective analysis. In reflective analysis, a researcher, according to these authors, mainly relies on his or her judgment to analyze the data that have been collected and often weaves case study data into a story. In Study I, as in reflective analysis in general, neither an explicit category system nor a prescribed set of procedures was applied. The study addressed the critical elements of data that bore relevance to the main objective of the study. In this regard, the reflective analysis of the participant’s oral description of the intervention and available information about her school performance played a pivotal role.

The analytical procedures used in Studies II-IV correspond to what Gall, Gall, and Borg (1999) call ‘interpretational analyses’. The analysis includes a systematic set of procedures to code and classify qualitative data to ensure that the important constructs, themes, and patterns emerge. Data collected in Studies II-IV included repeating patterns of the participants’ behavior and the instructional use of the elements of the meta-model that could be scored into analytical categories. Thus a quantifying qualitative analysis (Chi, 1997) was used in these studies.
In the beginning, the database which contained all the information collected for each study was prepared and data were subsequently divided into meaningful chunks of information such as a) descriptions of interventional sessions b) separate observations, c) short transcribed dialogic episodes between instructors and learners, d) the transcribed sequences of learners’ and instructors’ separate verbalizations, e) revisions of the meta-model and its elements f) sequences of content of the participants’ concept maps and their separate graphical elements.

Data-analysis of Study II, captured the use of the meta-model, its revisions, guiding interactive episodes mediated by a) the meta-model, b) the participant’s question generation process (including questions and other verbalizations and their development). Interactive episodes were analyzed using 11 classes of interactive patterns, which were created in the analysis. The content of the participant’s questions were analyzed in order to trace the influence of the guiding interactive episodes and the use of the orienting basis on question generation. The focus was on three areas: open-ended questions (i.e., requiring responses other than “yes” or “no”); verification questions inviting only short “yes/no” answers; and the character of information sought in the questions (e.g. instance feature specification, definition, goal orientation, causal antecedent). The conceptual framework used in the analysis shows convergence with the 18 question-content categories of the analytical schema (GPH) introduced by Graesser, Pearsson, and Huber (1992).

Data analysis in Study III included several different components. A qualitative content analysis by means of Atlasti -software with regard to sessions 6–20 was conducted on those sections that were regarded as relevant for answering the research questions. The first and second analyses focused on the participant’s 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 second analysis addressed the participant’s responses to the intervener’s subsequent requests to consider other meta-markers. The third analysis focused firstly on what kind of coherence and conceptual relations the participant was prone to ignore while he was tasked to come up with linking solutions; and secondly,
how the browsing of the conceptual model affected linking. Secondly, the difficulties were analyzed and focus was 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 episodes 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 five action types were established and selected as analytical categories.

In Study IV the analysis of the participants’ concept maps and video data from their review during the closing session of the seminar was conducted. The analysis of the concept maps included a) analysis of the content of node titles and descriptions and the language codes of the nodes b) analysis of the links and their language codes. Included were links between the titles of linked nodes and between the titles and descriptions inside nodes on the basis of the former node titles and description analysis, the analysis used the analytical categories created during the organization of data into meaningful segments. In addition, analysis of students' oral explanations of their concept maps and the teacher's comments on the presentations and concept maps was conducted using the analytical categories that were created.

**3.4.2 Statistical analysis**

In Study II a group of external evaluators was used to impartially evaluate the questions that the participant created in the four sessions of the intervention. The evaluators scored the questions using numeral scales and assessment criteria to which they had been previously introduced. The scores given by the evaluators served as quantitative data in Study II.

In Study II the external evaluators’ scores were statistically analyzed. The scores ranged from 1 to 4 and they were assigned to the four samples of the participant’s questions based on evaluation of their analyticity and predictivity. The analysis aimed at establishing possible, statistically significant differences between the scores given to the samples from the outset of the intervention and from its last sessions. Therefore the
scores given to the two samples from the outset of intervention and to the samples from the last sessions of the intervention were compared by means of paired t-tests with the SPSS program.

3.5 Reflections on the research strategies and trustworthiness of the studies

The research contexts of the studies of the present thesis posed three specific challenges related to the trustworthiness of the study. Consequently, these challenges had to be taken into consideration and addressed in selecting and applying research methods as well as in reporting the findings. First, due to the individual character of the interventions investigated in Studies I-III and the small number of participants in Study IV, the total number of participants in the study was small. Second, the meta-model investigated in Studies I-III was modified and revised during the interventions in these studies. Third, the researcher was involved as an intervener in the settings investigated in Studies I-III.

In what follows the research methods are examined from the perspective of three criteria of the trustworthiness (Guba, 1981), credibility, transferability, confirmability.

3.5.1 Credibility

Ensuring credibility can be seen as one of the most important factors in establishing trustworthiness in qualitative studies (Guba, 1981; Lincoln & Guba, 1985). According to Sandelowski (1986), a qualitative study can be regarded as credible when it presents such accurate descriptions of human experience that people who also share that experience would immediately recognize these descriptions. With regard to credibility, Yin (2003) emphasized the importance of incorporating correct operational measures for the concepts being studied. Such characteristics as a) clear research questions, b) compatibility between the research questions and case study design, c) appropriateness of sampling strategies, d) systematic data collection and analysis, as well as e) trustworthy correspondence between data and conclusions based on them are pivotal prerequisites for the credibility of qualitative studies (Anfara et al., 2002; Baxter & Jack, 2008; Russell et al., 2005).
In the present research the conciseness of the research questions was pursued by seeking such units of analysis in the studies as would make it possible to capture the participants’ unique actions mediated by the elements of the meta-model developed and explored. The *actions*, through which the participants were connected to the conceptual objects processed by the elements of the meta-model, served as a unit of analysis. The research questions in the studies were formulated in accordance with this definition of the unit of analysis.

The unit of analysis in the research itself highlighted the uniqueness of the instructional settings investigated. Consequently, the research questions based on the unit of analysis strictly contextualized the patterns of actions explored and analyzed to the instructional settings in which these patterns were observed. Similarly, quantification of qualitative data conducted in data analysis by using analytical categories (Studies II-IV) made it possible to pinpoint some repeating patterns of these actions as well as their transformations (Studies II-III). This methodical solution was intended to provide such systematic character of the research procedure as would ensure the compatibility between the research questions and research design.

Creswell and Miller (2000) identified eight verification procedures that improve the validity of qualitative research. They include (a) prolonged engagement and persistent observation, (b) triangulation, (c) peer review or debriefing, (d) negative case analysis, (e) clarifying researcher bias, (f) member checks, (g) thick description, and (h) external audit. Creswell (1998) recommends that at least two of these procedures should be used in any qualitative study.

In the present research, prolonged engagement and persistent observation were to a certain extent provided by the interventional character of the research settings in Studies I-III. This interventional character implied the regular exposure of the participants to the meta-model developed and thus afforded the intervener’s sampling of multiple situations in which the elements of the model were implemented. Triangulation from multiple data sources maximizes the range of data that might contribute to complete understanding of the phenomenon investigated (Krefting, 1991). Prolonged engagement and observations were not realized in Study IV, which was more limited than Studies I-III. However in this study, triangulation of data sources was implemented by combining data from the concept maps, the students’ presentations of these maps and the
instructional interactions between the students and the teacher. In addition, peer review was conducted by means of an inter-coder reliability test of the analytical categories used. In Study I, in turn, triangulation was implemented by combining data from interventional sessions with the data from the participant’s oral presentation and from the information on her learning activity outside the interventional sessions and school performance. In Study II the use of independent evaluators in examining the development of the participant’s questions provided a supplementary data source and a mean of triangulation.

The data collection implemented in the present research made it possible to capture the actions explored in the authentic instructional settings in which the meta-model under development was used. The sampling strategy permitted the thick description (Creswell & Miller 2000) of the action-specific analytical categories used in data analysis in Studies II-IV. These descriptive criteria can be seen to have supported the validity of research to a greater degree compared to the validity achieved by using interview techniques or surveys reconstructing the key characteristics of the activities after they have taken place. In this regard, the validity of the findings from Studies II-IV is unequivocally greater, in the author’s opinion than for the findings of Study I that served as a pilot study in the present research.

3.5.2 Transferability
The transferability or external validity of qualitative research refers to how well its findings fit into contexts outside the study situation (Guba, 1981) and conclusions can be generalized to a larger population (Anfara, et al., 2002). As Lincoln and Guba (1985) pointed out, transferability is more the responsibility of the person wanting to transfer the findings to another situation or population than that of the researcher of the original study. To address the problem of transferability the original researcher has to present sufficient descriptive data to allow comparison between the context of the study and the contexts outside the study. Brantlinger et al (2005) reviewing qualitative studies in special education pointed out that this kind of descriptions allow readers, for instance practitioners, to evaluate the relevance of reported findings to their own situation.

In the present research, analytical solutions promoting transferability were used to generate knowledge about the implementation of the meta-model for practitioners. The
challenges related to transferability were addressed by providing descriptive data including concrete examples about the use of the elements of the meta-model. In addition, the revisions of the meta-model investigated as well as the intervener’s actions in using the elements of the model Studies I-III were systematically described. Accordingly, in Study IV the elements of the digitalized modeling language were described in detail. The background information related to the participants and instructional settings was provided to the extent that was needed to describe the contexts of the studies in a way that affords comparisons with diverse contexts outside the studies. All of the information related to the use of the meta-model, instructional settings and participants was provided to maximize the transparency related to the research contexts and to allow readers to evaluate the relevance of the findings to their own situations. Finally, the discussion section of the thesis highlights the unique character of the findings of the research that do not argue for the straight mimicking of investigated interventions but rather illuminate various potentially useful ways for practitioners to utilize the elements of the meta-model.

3.5.3 Confirmability
The fact that the researcher in Studies I-III also functioned as the intervener posed a particular challenges related to the trustworthiness of these studies. A practitioner conducting an intervention can be seen to be potentially biased to overestimate the positive effects of the intervention. The intervener in Studies I-III had at the outset of these studies a 13-years’ experience in working as a psychologist; he had been involved in various interventions in his practical work with clients. He planned and conducted the intervention and collected as well as analyzed data in Studies I-III and collected and analyzed the data in Study IV.

Lincoln and Guba (1985) framed confirmability as the criterion of neutrality. Neutrality refers to the degree to which the findings are a function solely of the informants and conditions of the research not of other biases, motivations, and perspectives (Guba, 1981). Lincoln and Guba (1985) pointed out that the neutrality of data rather than the neutrality of investigator should be put at the forefront in considering the confirmability of qualitative studies. In order to properly address the aforementioned potential overestimation bias the body of evidence reflecting the effect
of intervention was explicitly limited in Studies II-III to the participants’ actions undertaken and possibly transformed in the course interventional sessions. The data analysis permitted one to present the character of these actions in a transparent way that allows a reader to estimate the effect of the interventions investigated, leaning on his or her own expertise.

According to Miles and Huberman (1994) the extent to which the researcher admits his or her own predispositions serves as a key criterion for confirmability. In this regard they emphasized the need to acknowledge the beliefs underpinning decisions made and methods adopted within the research report. In respect of results, the preliminary theories that did not immediately derive from data should also be discussed. In the present research the predispositions of the researchers were made transparent by introducing, in each of the papers reporting the findings, the theoretical positions underpinning the methodical solutions and the focus of data collection and analysis.

Detailed methodological description in qualitative studies enables the reader to determine whether data and constructs emerging from it can be accepted (Shenton, 2004). A reader should be provided with the “audit trail”, which allows any observer to trace the course of the research step-by-step via the decisions made and procedures described. In the papers on Studies II-IV readers are provided with descriptions of methods along with the stepwise specifications of the data analyses, their purposes and temporal order. Co-authorship in working on the papers reporting Studies II-III allowed the second author of these papers to assume the role of critical peer evaluator iteratively giving feedback about the clarity and possible ambiguities of the reported analytical procedures. The same author was the third author in the paper reporting Study IV and also had similar role in the co-authorship process.
4 Overview of studies and their findings

4.1 Study I

The purpose of Study I was to develop an orienting basis that takes the form of a conceptual meta-model to help the participant to process expository texts. The participant was acquainted with the meanings of the different types of touchable arrows that referred to various expository text structures. The text-structures signaled the causes, consequences, definitions, parts, types, examples, purpose, properties, activity or functioning of topic phenomena and various repeating and chronological stages, these items were reflected on during the sessions. Besides the touchable arrows, a touchable line that referred to the time continuum was implemented and introduced to the participant.

The utilization of the elements of the meta-model was integrated into the supported reading of chapters from textbooks in such school units of instruction as Worldview Knowledge, Religion, History and Human biology. Such text-topics as Cultural identity, First World War and Human bones were processed during the 6 sessions in the study. The participant was first asked to find the main issue of each chapter. Then the intervener helped the participant with touchable arrows to track, in the text its various structures and reflect on how they concerned the topic phenomenon. The intervener also asked the participant to type with a Braille type writer the reflected text-topic and short notes about the issues discussed with the elements of the meta-model on paper slips.

Touchable concept maps were constructed on the text-topic by attaching the paper slips with the typed topic on paper sheets and by arranging around it the typed notes with touchable arrows. The touchable arrows, each of which referred to the meaning of some of the elements of the meta-model, signaled the relations between the content of the notes and the main topic. The touchable time line was used to organize the discussed chronological stages and events related to the First World War. In addition, the participant’s father worked with her on a similar map of key events of the Second World War. Descriptions of the elements of the meta-model were dictated into a sound-track, recorded on a CD; the purpose of these was to guide the participant to process expository texts on her own.
After four sessions, held during the period of 8 weeks, the participant received excellent results from a test on worldview knowledge. Her marks on preceding tests of this subject had been only passable. She told her mother that she now has new thinking tools at her disposal. The participant began gradually to use the sound-track on a regular basis when reading texts related to her assignments, particularly in such subjects as geography and worldview knowledge. The participant’s oral presentation included in the data indicated that the implemented elements of the meta-model were in the process of being internalized as conceptual tools, orienting the participant to the frequent expository text structures. The presentation demonstrated that she could recall all the elements used in her intervention and perceived them as mental tools helping her to process expository text structures in reading as well as in writing.

When attending senior secondary school, the participant began spontaneously to use the elements of the meta-model in order to recall and reflect on various elements of the content of texts included in schoolbooks on psychology and worldview knowledge. For instance in attempts to refresh her memory about the content of a school text, called “Man and morals” the participant used such elements of the model as “Activities/functioning of the phenomenon”, “Examples of occurrence of the phenomena” and “Repeating stages related to the phenomenon”.

No evidence of a stable increase in the participant’s test scores was observed during the rest of the time period in which she attended upper secondary school. However, her school performance at senior secondary school turned out to be better than could be expected on the basis of her performance at upper secondary school. The participant’s test scores on the above subjects ranged from 7 to 9 and thus partially outstripped her scores on corresponding upper secondary school tests that had taken place before the intervention. The tests at the upper secondary school are widely known to be less challenging than the ones at the senior secondary school.

4.2 Study II

Study II explored the use of the elements of the developed meta-model in guiding the participant’s question generation in processing expository texts. The study was divided into two stages that differed with regard to the focus of data collection and analysis. During the first stage (9 sessions) the initial version of the meta-model was
implemented and modified by revising its guiding elements and integrating into it new elements that turned out to be useful during the sessions. The second stage of the study (11 sessions) focused on the usage of the modified meta-model in reflecting on the contents of new expository texts.

The process of revising and digitalizing the meta-model constituted a part of the analyzed data that provided findings about the implementability of the meta-model in the investigated intervention. In the intervention, the participant’s exposure to the elements of the meta-model was accompanied by concrete instructions regarding basic strategic procedures known to facilitate reading comprehension.

The episodes during which the participant generated questions occupied a central position in the first half of the intervention. The episodes related to the reflections on the given textual contents became more frequent during the second half of the process. The separate analysis of the episodes, which entailed clarifications of the meanings of the elements of the model, provided useful findings 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 meta-model or by elucidating the meanings of separate elements by exposing the participant to various material objects. The elements of the model referring to “Events, related to the phenomenon” (XI), “Phases, related to the phenomenon”(X) and “Forms of occurrence of the phenomena, (IX)” were involved most frequently in these clarifications. In addition to the verbal clarifications of the meta-markers “Parts, structure of the phenomenon”, “Phases related to the phenomenon” and “Types”, the meanings of the concepts “parts”, “types” and “phases” were illustrated via material objects such as a beach ball and an umbrella.

These elaborative activities related to the clarification of the elements of the meta-model led the intervener to modify the model in order to make it more comprehensible to the participant. Most of the revisions concerned the elements of the meta-model that turned out to be poorly comprehended during the first half of the interventional process. They were negotiated with the participant in order to find the conceptualizations which were optimally meaningful to him. During the revisions, the meta-model was expanded to include two new elements. The first of these elements referred to the means of
acquiring and constructing knowledge about the topic phenomenon and the second element referred to the frequency or likeliness of appearance of the topic phenomenon.

The findings from the participant’s questions and verbalizations shed light on how the meta-model enhanced his strategic question generation in processing expository texts and how its revisions made during the intervention process contributed to its usability in scaffolding question generation. The content analysis of the participant’s questions from the first three sessions revealed that the information sought in them was related to such issues as locations, costs, duration, characteristics, time of existence and definitions of the related topics and activities related to them. Some of questions were verification questions or else based on preconceived notions not immediately related to the topic. The participant was able to use the introduced external facilitators to expand the scope of the information that he sought in his questions. The elements of the meta-model thus led him to look into causal relations of the topic as early as during the second and third sessions.

Some of the participant’s responses to the exposition of the elements appeared to reflect his limited world knowledge. When the participant, for instance, was exposed to the meta-model in processing the text-topic related to umbrellas he expressed his understanding that there exist only one basic type of umbrella and no particular history is related to them. In his guidance mediated by the meta-model, the intervener drew the participant’s attention particularly towards those frequent expository text structures that he was prone to ignore in processing the texts and their topics.

The participant appeared to spontaneously employ some of the semantic constituents of the elements of the meta-model in the later sessions in a way that did not occur in his spontaneous questioning at the very beginning of the intervention. He thus started to consider the functioning of the discussed phenomena and regular phases related to their functioning or emergence in a way that was not pronounced in his earlier questions. The qualitative sequential analysis of the interactive guiding episodes and of the participant’s verbalizations established how the participant had begun, more consciously, to reflect on the ways the discussed phenomena can be affected. Statistically significant differences were established between the external evaluators’ scores on the analyticity and predictivity of the participant’s questions at the outset and during the last sessions of the intervention.
Data collected from the participant’s verbalizations in generating questions during the 20th session, firstly with minimal assistance and then by leaning on the meta-model, shed light on some of the potential benefits of the external use of the last, digital version of the model. The findings appeared to indicate that the external use that did not require the participant to recall the elements of the meta-model was helpful; it reduced his cognitive load when applying these elements to generate questions. The participant thus required more time to recall the elements of the meta-model than to come up with the questions applying them to the text-topic being processed.

4.3 Study III

In Study III the expanded version of the meta-model developed in Sub-studies I and II was implemented to explore how it can be used as an external schema of an orienting basis in facilitating the structure building actions a young blind reader. The study focused on examining how the separate elements of the meta-model served as scaffolding affordances that mediated the participant’s structure-building actions in processing the contents of expository texts.

Since the meta-model had to be tailored to fulfill the participant’s individual needs, three sub-versions of it were launched in the intervention in order to find the optimal solution. The first sub-version, a clock-board model contained 12 paper slips, each had a heading typed with Braille and referred to one element of the model. These elements were also converted into a set consisting of separate cards with Braille headings.

The second sub-version of the model was drafted in the form of an electronic text file and consisted of the headings of meta-markers and related notes including generic questions that were generated with the participant. The third, sub version of the meta-model, also drafted in a form of text-file was meant to facilitate the identification of linguistic markers expressing various coherence and conceptual relations in texts. For this purpose, the sub-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 elements of the model (see APPENDIX 1).

The interventional process consisted of 20 sessions. The interventional activities during the first 5 sessions mainly served as initial training exercises. They acquainted
the participant with the use of the conceptual model in elaborative questioning and 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, coherently organized texts.

The analysis of data from the participant’s first session demonstrates that he was prone to structure the text content on the basis of the phases of time course. He paid less attention to causal coherence relations between the text-topic and the separate elements of its content. During the last 15 sessions included in data analysis, the elements of the meta-model were implemented in various interventional activities. These activities included predictive question generation, search for correspondences between the elements of the meta-model and text sequences encountered in text processing, requested attempts to recall the content of texts processed by means of the elements of the meta-model.

These interventional activities were found, besides completing the immediate request, to lead the participant to spontaneously reflect on the text-content adhering to the conceptualizations that were related to the separate elements of the meta-model. In addition, in a number of cases he also spontaneously browsed the digital version of the model. The browsing mediated the establishment of the correspondences between the separate elements of the model and the meanings of text sections and reflections on their content.

Further analysis revealed that the participant most frequently did not use the elements referring to the causes and factors affecting the topic phenomena, their definitions and regular phases related to the phenomena discussed in the texts. The participant’s difficulties in detecting conceptual definitions were found to be due to the misinterpretation of a linguistic expression frequently used (in Finnish language) to define various phenomena.

The further analysis of the guiding episodes taking place during the intervention revealed that the intervener repeatedly drew the participant’s attention to the ignored text-structures. The analysis also revealed a number of guiding episodes during which the participant’s spontaneous or requested external use of the conceptual model affected his responses in reflecting on text-structures. Besides the general headings of the elements, the generic questions inserted in the model (for instance the questions related
to causality) appeared to have mediated the detection of related linguistic expressions and text-structures.

The analysis of the participant’s spontaneous use of the meta-model provided evidence that it was transformed during the intervention. In the earliest analyzed samples from the spontaneous use of the model it took place mainly externally through browsing the model and summarizing the text content linked to some element. In the latest samples the establishment of the correspondences between the elements and processed text-structures and their related summarization took place almost completely without leaning on the meta-model in the participant’s overt speech. The analysis of the spontaneous use of the meta-model also captured a number of the participant’s verbalizations functioning as reflections on the conceptualizations of the meta-model. Some of the reflections concerned the linguistic expressions in texts that the participant had previously not been able to associate with the elements of the model corresponding to their meanings. The participant undertook these kinds of efforts with regard to the expressions used in describing causality and defining phenomena. They preceded the first correct detection of the conceptual definition expressed with the common Finnish linguistic construction previously misinterpreted by the participant.

The findings indicate 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-centered propositional macro-structures. These elements were also found to have heightened the participant’s attention to some expository text-structures that he was prone to ignore in reading. The findings provide evidence of a certain tendency towards the partially internalized use of the elements of the meta-model and related conceptualizations while structuring text content.

4.4 Study IV

The study aimed to explore the potential opportunities and challenges related to the instructive use of the domain specific-modeling language, one based on the meta-model developed in the previous studies in assisting digital conceptual mapping as orientation activity in higher education. Study IV was conducted in a seminar of qualitative and mixed methods in the Institute of Behavioural Sciences, University of Helsinki.
Students conceptualized their developing understanding about qualitative and mixed methods by creating concept maps in pairs throughout the seminar.

The work on concept maps was supported by the modeling-language based on the elements of the meta-model developed in Studies I-III and investigated as a process of creation of orienting basis for the participants’ further research actions. In addition Study IV explored how the orienting-bases created by the students of the investigated seminar mediated the instructor’s guidance of them.

The separate elements of the meta-model developed in Studies I-III were used as reference structures in organizing the representation guidelines into separate elements of modeling language (see Table 2). The first cluster of elements was meant to afford the conceptual explorations related to qualitative and mixed methods. The second cluster of elements was designed to particularly support various practice related elaborations on the main topic of the seminar (see Table 2).

The analysis of the students’ maps revealed considerable diversity in the content and structure as well as differences in the use of the modeling language. The first pair of the students who participated in the study used a minimal variety of the elements of the modeling language and used description functionality in separate nodes. The links scored as structuring practice-related elaborations prevailed in the map of the pair over the links scored as structuring conceptual explorations. The pair repeatedly used the elements of the modeling language in reflecting on various dimensions of the qualitative research, these included data collection, selection of participant, data analysis and tools used from the perspective of the pursued characteristic of the research, trustworthiness (see APPENDIX 2). In presenting and clarifying the content of the nodes related to trustworthiness a partner from the pair described various trustworthiness issues to which he had been introduced before the course and which were thus included in the reflections in the map. The reflections on the trustworthiness issues organized with the elements of the modeling language thus can be seen to have partially mediated the explication of the prior knowledge that the partners had on trustworthiness.

The second pair of the participants of the study implemented a wider variety of the elements of the modeling language in listing and characterizing various methods, techniques, forms of data and dimensions of trustworthiness (see APPENDIX 3). They also repeatedly used the language elements in their reflections on the contexts of the
implementation of various methods and on their generic methodic principles based on background philosophies. The pair described how it used the node code “Background philosophy” in linking various not clearly philosophical “keywords” to various methods. When the presenter of the pair showed these conceptualizations in the closing meeting she framed them with more philosophically oriented expressions like “somehow mixes the positivistic and hermeneutic frameworks” or “more understanding background philosophy”. The pair described, in its comments, difficulties related to the conceptual distinction between the research strategies and methods as well as to the definition of various methodological concepts and their relations in general. In line with this concern, the pair, in its map, grouped the research methods and techniques partially under the same conceptual category.

Like the second pair, the third pair used the elements in listing and characterizing various methods, techniques, forms of data and dimensions of trustworthiness, it further used them in defining in a more detail one of the methods by means of an external knowledge resource. The third pair also used a language element in conjunction with a descriptive note inside a node in listing the concrete actions and procedures that improve reliability and in creating more detailed lists of the types of data that are used in qualitative research. A single separate conceptualization on a background philosophy that the pair created with language-element remained apart from the other nodes of the map of the third pair. Like the second pair, the third pair described the conceptual distinction between methods and research strategies as a challenging task. Referring to the unlinked node with the reflection on background philosophy, one of the partners of the pair characterized her understanding of the role of background philosophies as vague.

The teacher in her comments based on the concept maps categorized as being related to conceptual exploration repeatedly addressed the diverse methods and their philosophical underpinnings. These reflections were mediated by separate map elements and language codes that referred to methods and philosophical backgrounds exerting influence on the methods. The teacher capitalized on these reflections in her comments. Thus she, for instance, elaborated on the role of diverse background philosophies by pointing to the methods presented by the third pair in separate nodes in its map. The list of methods presented in one node of the map created by the first pair triggered
discussion on the difference between two separate methods, ethnography and ethnomethodology.

The teacher’s practice-related comments on map elements highlighted such issues as the ways of describing research procedure as an aspect of trustworthiness and types of collected data and the character of studied phenomena. These reflections were mediated by the elements of the maps and language codes that referred to trustworthiness, diverse methods and the contexts of their implementation. The teacher repeatedly emphasized the characteristics of a phenomenon, the available data and the research strategy that most optimally suits these characteristics as noteworthy starting points to be addressed in creating concept maps on qualitative research.

Besides the use of the map elements in illustrating various domain-specific issues, the teacher commented on the students’ ways of creating their maps. These comments focused on how the concepts, entities and their interrelations were presented in the maps. However, they were made in conjunction with more content driven comments. Some of these comments entailed suggestions on how the work on the concept maps might be continued.
5 Discussion

5.1 General discussion

The findings on the use and functioning of the elements of the meta-model developed in the present research shed light on various opportunities provided by their instructional implementation. A common characteristic between the all four studies is that the participants were guided to systematically approach the topic of their elaborations from the perspective of a set of conceptual and relational structures in the investigated settings. These structures were initially selected and formulated in Study I in processing the participant’s various expository texts included in her school books.

In Studies II and III, these structures, compiled as the elements of the meta-model, were iteratively modified to be suitable to the participants and the contexts of the interventions in processing again various expository texts and text-topics. Since coherence is considered as a basic organizing device in expository texts in general (McKeown et al., 1992; Graesser et al., 2003), the elements of the meta-model can also be seen to have mediated the coherence of the participants’ elaborations. Thus these elements functioned as cultural tools, crystallized templates (Stetsenko, 1999) for organizing knowledge into coherent structures.

There was a discontinuity between Studies I-III and Study IV in respect of the addressed pedagogical challenges and the use of the elements of the developed meta-model. In Study IV, the field of qualitative and mixed methods, instead of various expository texts, assumed the role of conceptual object of the participants’ orienting activity. In addition, the meta-model was contextualized to this specific domain and converted into the form of a modeling language used in concept mapping. In Study IV, the participants’ conceptual mapping scaffolded by means of the contextualized elements of the meta-model was also investigated as orienting activity. However, differing from their use in Studies I-III, the elements were not employed as a schema of the orienting basis, but as separate suggestions about what to consider in creating a schema of orientating basis for the implementation of qualitative and mixed methods. In what follows, some contributive relations between the various interventions in the studies, accumulated findings and the design of consecutive studies are summarized.
In Studies I-III the elements of the meta-model mediated the participants’ elaborations on separate text-topics. The focus of their implementation was put on the enhancement of the participants’ understanding of the significance of various generic expository text-structures and on the facilitation of the use of these structures in their elaborations on various text-topics. The contextualized and specified elements of the model in Study IV, however, mediated the participants’ elaborations on various subtopics (methods, data-collection, data-analysis etc.) related to qualitative research. In Study IV the elements were used to highlight some central domain-specific conceptual and relational structures with the semiotic devices that the participants could incorporate into their modes of using signs and symbols in concept mapping.

The elements of the developed meta-model in many respects converge with the conceptual elements of previously designed instructional methods in text-processing (Meyer & Poon, 2001; Meyer et al., 1989; O’Donell et al., 2002). Some of these convergences and apparent divergences are now discussed in more detail. The focus in the development of the meta-model and the further design of its elements was put on the structures resembling the global knowledge prototypes that were implemented in the TCU knowledge-mapping system (O’Donell et al., 2002). A theoretical rationale for this focus was provided by Galperin’s account of orientation as activity that aims at the creation of the overall image of a problem situation, including its elements and their functional significance and interrelations. Further, the findings from Study I demonstrate that the emphasis on the macro-level ideas in the participant’s authentic school texts considerably benefitted her in processing these ideas and related text structures.

In Studies II-III particular attention was devoted to the clarifying conceptualizations of the elements of the meta-model that were in part negotiated with the participants. This interactive process and the clarifying conceptualizations in the model emphasized various linguistic constructions that are, in many respects, analogous to the linguistic elements explicated within Structure Strategy Training (SST, Meyer & Poon, 2001). Thus, in Study III various linguistic expressions used in expository texts represented by the elements of the meta-model were introduced to the participant to support their detection and identification. However these linguistic expressions were discussed in Study III in respect of more global macro-level ideas and conceptual relations than the
text-structures reflected on in SST. Thus, for instance, sequential structures were, in reflection, considered in respect of whether they referred to chronological or regularly occurring events or phases. Comparison as text-structure was discussed in relation to the typologies of various topics appearing in expository texts. This characteristic of the reflections can be seen to have drawn the participants’ attention not only to various superficial features of expository text-structures but the diverse culturally established criteria for coherent, analytic, knowledge-organizing actions that these structures convey in exploring various phenomena.

Unlike the structures in the TCU knowledge mapping system, the structures that were presented by the elements of the meta-model used in the present study were also elucidated with heuristic questions. These questions occupied a central role in guiding interactions, particularly in Study II; they also mediated the participant’s structuring elaborations in Study III. Both the heuristic questions and other clarifying expressions (ones created and iteratively modified in Studies II and III) served in the creation of the guiding conceptualizations integrated into the modeling language in Study IV. Study IV thus served as an experiment on how the elements of the generic meta-model developed and tested in Studies I-III may be specified and instructionally implemented in one domain-specific context.

A central content-specific characteristic distinguishing the meta-model investigated from the aforementioned instructional approaches is the way it explicates various conceptualizations of human activity. The use of this conceptual framing stemmed from both the planning component of orientation introduced by Galperin (2002) and the Activity System Model introduced by Engeström (1987). In the meta-model, activity and functioning were integrated into the same conceptual frame since both of these concepts can be referred to in Finnish language with one word toiminta; English, depending on context: activity, action, agency, function.

The participants in Studies I-III were found to use the elements of the meta-model referring to the activity or functioning while they were organizing their elaborations both spontaneously and after the intervener’s requests. This element thus mediated the interactions between the participants and encountered or anticipated text-structures. Therefore it was particularly emphasized in designing the modeling language in Study IV, there, the participants created concept maps to reflect on methods and their
peculiarities as well as on various concrete practices related to research and the use of methods. The emphasis put on the reflections on practices and their peculiarities can be viewed as expanding the applicability of concept mapping to include wider conceptual dimensions than the conventional hierarchical and part-whole conceptual relations used.

In what follows the findings from the present research are discussed from the perspective of the research questions.

5.2 Discussion on the findings related to the research questions

The findings help find the actions, transformations and instructional episodes that the elements of the meta-model afforded, while they were used in the investigated settings. The original studies also yielded findings that help identify difficulties and misunderstandings the participants encountered when they applied the elements of the meta-model and how the participants’ understanding of these conceptual elements was transformed.

As described in the previous sections of this introduction the elements of the meta-model were implemented differently in Studies I-III and IV in respect of the degrees of freedom provided to the participants when they used these elements. The zones of free movement and promoted actions took various forms in the studies.

5.2.1 Findings regarding the first research question

The first research question of the present thesis asked, what are the actions (their kind) that were afforded and promoted by the elements of the developed meta-model while they were used a) to direct the participants’ orienting actions (in the zone of free movement, ZFM) and b) to provide suggestions about what to address with orienting actions (in the zone of promoted actions, ZPA).

Table 6 summarizes the key findings that help to answer the research question. In Studies I-III, the intervener used the meta-model and its elements in structuring the participants’ interactions with the encountered or anticipated structures of the texts processed. Thus, using the terminology borrowed from the Valsiner’s zone –theory, the use of the meta-model can be interpreted to have mainly taken place within the participants’ zone of free movement (ZFM). The elements of the model provided the
participants with a conceptual framework to be leant on in arranging the meanings of various sections of the processed texts. This arranging took place in the course of instructional discourse delineating the interpretation of the elements of the meta-model in relation to diverse texts.

Table 6. Key findings helping to answer the first research question

<table>
<thead>
<tr>
<th>Studies</th>
<th>Key findings and their interpretations</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>The participant appeared to have internalized the elements of the meta-model as a structural framework, a thinking tool that she used in processing and reflecting on various topics.</td>
</tr>
<tr>
<td>II</td>
<td>The participant was able to use the introduced external facilitators to expand the scope of the information that he sought in his questions. The elements of the meta-model thus led him to look into causal relations concerning the topic as early as during the second and third sessions.</td>
</tr>
<tr>
<td></td>
<td>The participant appeared to spontaneously employ some of the semantic constituents of the elements of the meta-model in the later sessions in a way that did not occur in his spontaneous questioning at the very beginning of the intervention.</td>
</tr>
<tr>
<td></td>
<td>The participant started to consider the functioning of the discussed phenomena, affecting them factors and regular phases related to their functioning or emergence in his questions in new ways that were not evident in his earlier questions. The questions were also found to have been transformed in respect of their analyticity predicting better than previously the content of the texts processed.</td>
</tr>
<tr>
<td>III</td>
<td>The participant was found to have gradually incorporated some of the elements of the meta-model as part of his text-structuring actions which increasingly drew his attention to the common expository text-structures that he was previously prone to ignore or misinterpret.</td>
</tr>
<tr>
<td></td>
<td>The participant started spontaneously to reflect on the conceptualizations of the meta-model and related linguistic expressions in texts referring to definitions and causality that he had previously not been able to associate with the elements of the model corresponding to their meanings. These reflections preceded the first correct detection of the conceptual definition expressed with the common Finnish linguistic construction previously misinterpreted by the participant.</td>
</tr>
<tr>
<td>I-III</td>
<td>The findings illustrate how a learner’s cognitive movements within a system based on distributed cognition and mediated by the elements of the meta-model can gradually result in partial internalization of the cognitive processes contributing to the understanding of expository texts initially taking place by means of external actions.</td>
</tr>
<tr>
<td>IV</td>
<td>The participants were found to repeatedly implement some of the contextualized and digitalized elements of the meta-model in elaborating on various dimensions of the field of qualitative and mixed methods as well as related practices.</td>
</tr>
<tr>
<td></td>
<td>Some of the codes were repeatedly used by the participants to list, characterize and compare the research paradigms in respect of their philosophical backgrounds and thus organize conceptual knowledge (the exploratory component of the orienting basis of action).</td>
</tr>
<tr>
<td></td>
<td>The processing of planning knowledge (planning component of orienting basis of action) took place a) when the pairs systematically reflected on the implications of</td>
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</table>
the pursued feature of research, trustworthiness for various research activities, and b) when they elaborated the suitable contexts of the implementations of the diverse research paradigms.

- The findings illustrate how the contextualized elements of the meta-model used as a preliminary orienting basis can facilitate the creation of elaborative connections between practice-driven and more abstract concept-driven knowledge structures.

The findings from Studies I-III demonstrate that the meta-model developed across these studies can be used to orient a reader’s reading strategies as behavioral actions (Graesser, 2007) towards common expository text structures. Even when used in the participants’ ZFM, the elements of the meta-model were not leant on as algorithmic action steps. Instead, they functioned as prompts intended to be systematically considered as potentially implementable, organizing means to structure text-topic-related elaborations. Some of the elements did, and the others did not have relevance to the currently processed text-topics and encountered expository text structures. The participants thus, were required to use the elements, reflectively, as conceptual resources (Gillespie & Zittoun, 2010). This finding also corresponds to what Furber, Kluge and Ludvigsen (2013) characterized as slowing down the sense-making process by opening up a space for interpretation and negotiation.

The use of the elements of the meta-model functioning as the exploratory component of an orienting basis of action (Galperin, 2002; Reshetova, 2004) engaged the participants in elaborations that challenged their current orientation towards the topics and structures of the texts. The findings from the Studies I-III revealed that the participants gradually incorporated the elements of the meta-model (at least some of them) as the aspects of their actions. This kind of incorporation can be viewed as a worthwhile interventional mechanism in working with the learners whose awareness of text structures or other targeted topics is undeveloped due to limited learning experiences or learning difficulties.

It is proposed that the findings demonstrate how the use of the meta-model in regulating the zone of participant’s free movement in processing texts contributed the progressive relocation of scaffolding agency (Holton & Clarke, 2006) from the intervener to the participant. In this respect the elements of the meta-model as sign-creating material anchor, mediated this relocation because they were available to be used by the participant without the intervener’s immediate help. The aforementioned
findings also illustrate how a learner’s cognitive movements within a system based on distributed cognition can gradually result in partial internalization of the cognitive processes initially taking place by means of external actions.

The fact that the participants in Studies I -III started to use the elements of the meta-model as a conceptual framework in processing various text-topics demonstrates that they understood their meanings and applied them to new situations. However this required the transformation of the participants’ initial meaning frame in processing expository texts. The recursive use of the meta-model in the participants’ ZFM appears to have contributed to this transformation. It is congruent with what Anderson and Kratwohl (2001) identified as the criterion of the acquisition of conceptual knowledge, the capability of explaining concepts in some domain in one’s own words and transferring information to new situations. The participants’ conceptual knowledge that was expanded during the interventions in Studies I-III was related to expository text structures and their meanings; also to linguistic features and functions in organizing text coherence, as well as to knowledge in general. This expanded conceptual knowledge as the acquired, exploratory component of the orienting basis of action (Galperin, 2002; Reshetova, 2004) can be seen to have considerably benefited the participants in processing various expository texts.

The process by which the participants gradually incorporated the elements of the meta-model as aspects of their explorative actions is in some respects analogous to the learning process that within Meyer and Land’s (2005) framework of Threshold Concepts, in particular that which falls under the concept liminal space. ‘Liminal space’, within this framework, is conceived as a transformative state in the process of learning in which there is a reformulation of the learner’s meaning frame (Schwartzman 2010). Learning in the liminal space entails the acquisition and use of new forms of written and spoken discourse and their internalization.

The findings from the present research shed light on how the investigated learning processes that assumed some pursued features of liminal space can be operationalized by organizing and analyzing the participants’ orienting activity in the variously structured settings. In this regard, the learning process, as it assumes some aforementioned features of liminal space, can be organized and explored through slowing down learners’ sense-making process in their orienting activity. The systematic
structuring of the learners’ zone of free movement (ZFM) in acting with the target topics may be needed to provide sufficiently repeated exposures to some central conceptual, domain-specific entities and relations that they are prone to ignore. The repeated exposures to the key dimensions of a subject matter with the structures analogous to the meta-model developed in the present study can function as mediators that result in changes in the subject acting with them (Wertsch, 1998). These structures help to maintain the stability of the content of instructional discourse needed to promote changes. The materialized structures support learning activity, the entire object of which is the transformation of the modes of subject’s acting and orienting him or herself towards the target phenomenon of learning.

In Study IV the contextualized elements of the meta-model in the form of codes of modeling languages highlighted some conceptual structures in the virtual environment in which the participants were supposed to work on concept maps. In this respect the contextualized elements functioned as a preliminary orienting basis (Terlow, 1993), a set of suggestions for the participants on how to create the exploratory and planning components of the orienting basis of action (Galperin, 2002; Reshetova, 2004) for their further use of qualitative and mixed methods.

Conceptual mapping thus constituted a zone of free movement (ZFM), with constraints and degrees of freedom that technologically structured the participants’ reflections during the seminar. Such a conceptual mapping that constituted the ZFM was needed to engage the participants in externalizing their understanding of the main topic of the investigated seminar, i.e., various aspects of qualitative and mixed methods. The elements of the modeling language, in turn, constituted a sub-zone of promoted actions (ZPD, Valsiner, 1998) in this zone. The modeling language used in the investigated setting was designed by contextualizing the elements of the model to the topic domain and by converting the contextualized elements into the default set of language codes. The participants could decide, for themselves, which codes of modeling language they would use in creating the orienting bases for their further use of the qualitative and mixed methods.

In Study IV, the use of the codes of the modeling language in the ZPA offered more degrees of freedom to the participants than in Studies I-III. Using the codes according to their own preferences, the participants could also create various subtopics being
reflected upon with the codes in their concept maps. This opened up an opportunity to implement a wide variety of the combinations of modeling elements in creating diverse sub-topic-driven macro-structures in the orienting bases. This flexible characteristic of a modeling language as a scaffolding device distinguishes it from conventional textual templates used to scaffold learners’ elaborations.

The use of the modeling language in Study IV differs from the strict concept-driven representational guidance used in some concept-mapping studies (Bramwell-Lalor & Rainford, 2014; Kumar et al., 2011; Oliver, 2008). The codes of the modeling language, here, mainly marked open-ended domain-sensitive conceptual structures to be specified with concrete concepts or descriptions and only one specific concept, “trustworthiness”, was provided. The codes based on the expository text structures modeled in Studies I-III marked some widely used but contextualized discursive paths constituting a preliminary orienting basis (Terlouw, 1993) meant to promote the participants’ orienting activity. Once the participants had selected the language codes that they started to utilize in modeling, they repeatedly used the same codes. This repeated use of selected codes appeared to have supported the systematic and coherent structure of the participants’ elaborative actions while providing greater degrees of freedom than predefined sets of specific concepts. This instructional mechanism can be seen to hold promise for the initial stages of concept mapping since students embarking on higher-level studies have been often found to face the challenge of expressing their ideas in a systematic and coherent way (Bramwell-Lalor & Rainford, 2014).

The findings from Study IV can be viewed as indicating that the digitalized language codes mediated the organization of a) conceptual knowledge related to the exploratory component of the orienting basis of action (Galperin, 2002; Reshetova, 2004) and b) planning knowledge related to the planning component of the orienting basis of action (Galperin 2002; Reshetova, 2004). Some of the codes were repeatedly used by the participants to list, characterize and compare the research paradigms in respect of their philosophical backgrounds and thus organize conceptual knowledge (exploratory component of the orienting basis of action). The processing of planning knowledge (the planning component of the orienting basis of action) took place a) when the pairs systematically reflected on the implications of the trustworthiness for various research activities and b) when they elaborated the suitable contexts of the implementations of
the diverse research paradigms. The aforementioned findings indicate that the language codes encouraged the participants to organize their domain-specific conceptual and practice-related elaborations into the same representational space in their orienting bases. This demonstrates that the contextualized elements of the meta-model used as a preliminary orienting basis can facilitate the creation of elaborative connections between practice-driven and more abstract concept-driven knowledge structures which is identified as a fundamental issue in education (Kinchin et al., Cabot, Kobus & Woolford, 2011).
5.2.2 Findings regarding the second research question

The second research question of the present dissertation asks, how did the participants’ responses and conceptualizations in the ZFM and ZPA while participants used the elements of the meta-model mediate the instructor’s guidance in the zone of proximal development of their orientation actions, while they were processing conceptual objects.

Table 7 summarizes the findings that help to answer this research question.

Table 7. Key findings helping to answer the second research question

<table>
<thead>
<tr>
<th>Studies</th>
<th>Key findings and their interpretations</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-III</td>
<td>• When the elements of the meta-model in Studies I-III were used in the participants’ zone of free movement in structuring their orienting actions the participants systematically informed the intervener with their actions about how they understood and applied the elements. This systematic feedback loop established the basic reference frame that the intervener used in outlining the possible states of the participants’ interactions (zone of proximal development).</td>
</tr>
</tbody>
</table>
| II      | • In Study II the intervener exposed the participant, using the elements of the meta-model, to the text-structures the importance of which he was prone to underestimate in generating questions on the related text-topics.  
  • Such elements of the meta-model as “Events, related to the phenomenon” (XI), “Phases, related to the phenomenon”(X) and “Forms of occurrence of the phenomena (Types), (IX)” were concerned most often in the clarifications emphasizing the role of related structures in expository texts. In addition to the verbal clarifications of the elements of the meta-model, “Parts, structure of the phenomenon”, “Phases related to the phenomenon” and “Types”, the meanings of the concepts “parts”, “types” and “phases” were illustrated by material objects such as a beach ball and an umbrella.  
  • These elaborative activities, ones related to the clarification of the elements of the meta-model, led the intervener to modify the model in order to make it more comprehensible to the participant. The revisions were negotiated with the participant in order to find the conceptualizations which optimally conveyed their meaning to him. |
| III     | • The repeated exposure to the elements of the meta-model and the corresponding structures and macro level ideas in texts allowed the intervener to address in the intervention the text-structures that the participant ignored or interpreted erroneously.  
  • The participant’s difficulties in detecting conceptual definitions were found to be due to the misinterpretation of a linguistic expression frequently used in the Finnish language to define various phenomena.  
  • The intervener repeatedly drew the participant’s attention to the ignored text-structures referring to the causes and factors affecting the topic phenomena, to their definitions and to regular phases related to the phenomena discussed in the texts. |
| IV      | • The instructional episodes that were motivated by the separate elements of the participants’ concept maps (created with the modeling language) put emphasis on such global domain-specific knowledge structures as relations between research strategies and their background philosophies, investigated phenomena and
When the elements of the meta-model in Studies I-III were used in the participants’ zone of free movement in structuring their orienting actions the participants systematically informed the intervener, through their actions, about how they understood and applied the elements. This systematic feedback loop established the basic reference frame that the intervener used in outlining the possible states of the participants’ interactions (zone of proximal development) with the environment including the elements of the model as well as processed text-materials. The feedback loop thus shaped the instructional discourse itself.

The findings from the process of revising the meta-model and its use in Studies II and III demonstrate how the model as a set of sign-creating material anchors, allowed the intervener to maintain the conceptual stability of this content while scaffolding the participants’ elaborations. This stability was required to systematically draw the participants’ attention to the common structures in expository texts, particularly those that they were prone to ignore. From the perspective of the distributed cognition metaphor, it appears plausible to assume that scaffolding was thus realized by the system including a) the participants, b) the intervener/teacher, c) the elements of the meta-model used and d) the instructional discourse, the content of which was shaped by the use of the elements.

In Studies I-III the intervener regulated the participants’ ZPD in relation to both the exploring of the meaning of the elements of the model and to the use of the elements in processing text-topics and contents. Thus, in Study I the intervener created various material versions of the model mediating the participant’s interaction (implementation of sensory arrows and audio-recording) and its elements on the basis of the experiences from the intervention sessions. In Studies II and III, the subsequent versions of the
model were endowed with the participants’ own conceptualizations and expressions as well as expanded to include two new elements. All these revisions were based on the experiences from the participants’ previous actions and delineated their potential next actions with the model. The revisions allowed the intervener to convey the meanings of the elements in a linguistic form that corresponded to the participants’ ways of using and understanding language. The revisions thus externalized the intervener’s interpretation of the participants’ zone of proximal development in using the meta-model and in processing related expository text-structures within the interventions.

The intervener applied the elements of the model context-sensitively in processing the various expository texts and topics of the participants; this allowed him to repeatedly evaluate how they consciously addressed or detected related conceptual dimension and text-structures. In Studies II and III, the participants’ attention was drawn to the macro-level ideas and related structures that they ignored in processing the texts, by means of the elements of the meta-model. In Study II, the intervener thus exposed the participant, using the elements of the meta-model, to the text-structures the importance of which he was prone to underestimate in generating questions on the related text-topics. The repeated exposure to the elements of the meta-model and the corresponding structures and macro level-ideas in texts in Study III allowed the intervener to address in the intervention various common linguistic expressions that the participant did not accurately interpret. The findings thus appear to indicate that the systematic use of the model in the reader’s zone of free movement (ZFM) can serve the accumulation of experiences about the particularities of his or her actions in processing various expository text structures. These experiences, in turn, help an instructor to hypothesize the zone of proximal development (ZPD) of the learner’s reading comprehension.

The findings from the participant’s spontaneous use of the meta-model in Study III also suggest that the model to which a learner is accustomed according to his or her individual needs may mediate the learner’s spontaneous text processing efforts in the ZPD. The regular modification of the elements of the model in conjunction with verbal guidance thus allows an instructor to regulate the space for a learner’s interpretations (ones opened up by the use of the elements) by slowing down his or her sense-making process.
The codes of the modeling language used by the participants in organizing their conceptual and practice-related elaborations in Study IV mediated the instructional discourse by providing the teacher with a window into the current state of the students' understanding of the domain. They served the domain-specific cognitive mediation (Karpov & Haywood, 1998) of scaffolding by providing various domain-specific conceptual directions during the process of creating the concept maps and in the subsequent instructional discourse. The teacher could correspondingly follow these directions in delineating, in her comments, the zone of the students’ proximal development, a) by explicating the various possible and recommended ways of developing the understanding of the domain and b) by introducing related knowledge.

The instructional episodes that were motivated by the separate elements of the participants’ concept maps showed an emphasis on such global domain-specific knowledge structures as those regarding relations between research strategies and their background philosophies, the investigated phenomena and trustworthiness issues. The repeatedly used language codes mediating the teacher’s gestures can be seen to have visually highlighted the systematic character of these structures, for instance drawing the participants’ attention to the fact that diverse research strategies have their own, particular philosophical backgrounds. The elaborations of the contexts of the implementation of the research strategies evoked the teacher’s comments that dealt with the character of a phenomenon and with the available data as a recommended starting point in creating concept maps on qualitative and mixed methods. These crucial comments encouraged the participants to advance their orientation towards strategic knowledge (deJong & Ferguson-Hessler, 1996; Shavelson et al., 2005), especially regarding when, where and how to apply diverse research strategies.

The findings of the present research convincingly show how the elements of the meta-model, tailored to various learning contexts together with their users, can constitute an instructional part of a cognition system in distributed orienting activity, in particular, activity, that processes complex conceptual objects. Both the elements of the meta-model and the elaborations mediated by these elements also assumed the role of shareable objects of thought (Kirch, 2010) and communicated thinking (Haenen, 2001) that shaped the instructional discourse between the participants and the instructors.
Various dimensions of the conceptual objects processed in the studies were discussed and interpreted by the participants, intervener (Studies I-III) and teacher (Study IV) by leaning on the various versions of the elements of the meta-model or on the elaborations mediated by these versions. These interpretations can be seen to have organized discrete dimensions of the processed conceptual objects into specified conceptual and relational structures performing the function of perspectival understanding (Greeno & van DeSande, 2007) of these objects. The intervener and teacher reflected on the perspectival understanding (and its limitations) expressed at the participants’ elaborations. From this reflection came their oral or textual guidance, which might explicate the possible next states of the interaction between the participants and the knowledge processed (ZPD, Valsiner, 1987).

The elements of the meta-model, by prompting the participants to use such knowledge organizing means as defining, describing, and typologizing also exposed them to the specific challenges related to the topics processed. The participants’ difficulties in dealing with these challenges helped the intervener in Studies I-III and the teacher in Study IV to adjust the guidance offered. Study IV and its findings support the author’s position that the elements of the meta-model can be used to instructionally explicate some domain-specific ways to delineate and distinguish central phenomena, typologies, practices, dependencies and influences. Compiled into a preliminary orienting basis (Terlouw, 1993) used in concept mapping these kinds of delineations can function as embedded domain-specific representational guidelines. The learners’ sense making is mediated by these guidelines; in turn, it lets an instructor know how they orient towards the domain-specific conceptual and practice driven knowledge and helps him or her to adjust guidance accordingly. This instructional mechanism can be seen to promote the coherent and integrated modeling of concept-based understanding and practice-based competence regarded as crucial in expert training (Kinchin & Cabot, 2010).

5.3 Critical considerations and conclusions

The present research demonstrates how Valsiner’s zone theory can be used to operationalize the guidance of learners’ orientation activity and its dimensions distinguished by Galperin. The author has presented evidence that the concepts of ZFM
and ZPA are useful conceptual tools in considering what constraints, degrees of freedom and set of scaffolds are needed to provide efficient pedagogical settings for the learners developing actions and their orienting bases. The use of the zone theory challenges practitioners to explicitly identify a) the orienting actions (their kind and character) they will use to engage learners, b) the choices the learners are permitted to have in undertaking these actions and c) the orienting devices which draw the learners’ attention to some specific content of learning.

In the present research Valsiner’s zone theory was used to operationalize the use of the aforementioned meta-model in promoting the participants’ orienting activity in processing complex conceptual objects. The original studies served both the development and testing of the meta-model and partially, due to the needs related to the designing process the elements of the model were used following relatively strict systematic procedures in Studies I-III. Scaffolding learners in daily learning environments and rehabilitative interventions presumably requires more flexible approaches. Thus, for instance Donovan and Smolkin’s (2002) research revealed that while scaffolding can assist learners, it can also hinder their achievements when given in the form of directive instructions.

The implementation of the elements of meta-model developed in the original studies to assist readers or writers in daily learning settings may more flexibly serve scaffolding when the elements are mainly used in the zone of promoted actions. If a learner frequently displays a proneness to ignore crucial structural features commonly used in expository texts, he or she can be prompted to act with the related, contextually specified elements of the meta-model to address the ignored features. Consequently, the instructor or intervener can convert some of the contextually specified elements and related individually tailored guidelines into a digitalized form to maintain the conceptual direction of the instructional discourse.

The findings from the Studies II-III shed light on the possible structures of the guiding interactions in which a learner is provided with an opportunity to generate his or her own unassisted elaborations before the instructional use of the elements of the meta-model. Sufficient space and time given to a learner’s own reflections can be seen as a crucial prerequisite for the optimal combination of the unassisted and assisted processing of various conceptual topics. It is also important to note, that expository texts
often include more than one major conceptual topic and that the elements of the meta-model may be useful in processing multiple paragraphs and sub-topics within a single text.

The findings from Study IV provide an example of the repeated reflective use of the contextually specified elements in the students’ elaborations regarding qualitative and mixed methods. An integrated use of concept mapping, mediated by visual language codes in conjunction with reflective discussions, appears to have supported a strongly multi-modal joint working mode in the setting in Study IV. These discussions visually utilized the elements of the created maps. Different modalities used in an educational context can function as meaning-making resources that facilitate the learning of concepts and conceptual sense making by allowing the learners to articulate them in various ways (Furberg et al., 2013; Pozzer-Ardenghi & Roth, 2007).

Since the original studies has limitations related to the development of the meta-model itself that took place during these studies, further efforts are needed to explore more systematically how it may be pedagogically implemented in various contexts. Semiotically afforded orienting activity can be seen as a noteworthy instructional approach to address and deal with various domain-specific complexities, particularly nowadays when versatile digital functionalities are broadly available in educational settings. In this regard the elements of the meta-model explored in the present research as a generic conceptual frame are offered for use heuristically to pinpoint crucial specific epistemic features (Reiser, 2004) and related knowledge structures underlying a particular domain. Instead of separate concepts used in scaffolding, the implementation of the meta-model as the framework of representational guidance shows the need to reflect on various conceptual and relational configurations that serve the coherent organization and creation of knowledge in a domain. These reflections, in turn can promote the schematization of domain-specific knowledge-organizing means, for instance diverse discursive systems for analyzing causes and dependencies, using typologies or describing procedures to promote learners’ orienting activity.
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### Appendixes

APPENDIX 1. The last version of the used meta-model

<table>
<thead>
<tr>
<th>Meta-marker</th>
<th>Notes</th>
</tr>
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</table>
| I Definition  | **Question:** What is the main thing about?  
*Expressions:* "The main thing is, the main thing refers to" |
| II Causes, affecting factors | **Questions:** Where does the main thing get its start from? What affects it? What is an inevitable prerequisite for it?  
*Expressions:* "stems from, is caused by, based on, explained by, the main thing is affected by, the main thing is increased by, is reduced by, is alleviated by" |
| III Purpose/task | **Question:** Why is it created?  
*Expression:* “The main thing is purported to, the purpose of the main thing is, One aims with the main thing at…” |
| IV Activities | **Questions:** What is being done with it? How does it act/function? What kind of activity is related to it? What is the activity directed to? What kinds of means or tools are used? |
| V Examples | **Question:** What kind of examples of the activity/functioning of the main thing exist? |
| VI Properties | What is it like? |
| VII Parts, structure | **Questions:** What does it consist of? How are the parts related?  
*Expressions:* “consists of, contains” |
| VIII Consequences | **Questions:** What does it cause? What does it lead to? What does it affect?  
*Expressions:* “The main thing causes, leads to, produces, increase, decrease, alleviate” |
| IX Forms of occurrence | **Question:** In what kind of different forms does it exist?  
*Expressions:* There are different species, types, tribes, groups, fields of… |
| X Regular phases | **Questions:** What kinds of things or phases that take place repeatedly in the same order are related to the activity or existence of the main thing? Does the main thing have a... |
kind of repeating lasting period or period?

*Expressions*: “First, at the beginning, then, every day, monthly, yearly” “lasts approximately”

<table>
<thead>
<tr>
<th>XI Phases in the history and future</th>
<th>Questions: What has happened with regard to the main thing? What is planned or expected to happen in the future?</th>
</tr>
</thead>
<tbody>
<tr>
<td>XII Location</td>
<td>Where is the main thing located, where does it occur where does it take place?</td>
</tr>
<tr>
<td>XIII How does one get knowledge about the main thing?</td>
<td>How is the main thing investigated or observed? How is its existence proved?</td>
</tr>
<tr>
<td>XIV Frequency</td>
<td>How common is it? How many examples of it exist?</td>
</tr>
</tbody>
</table>

APPENDIX 2. A section of the concept map of Pair 1 referring to the important features of data analysis and the tools used from the perspective of trustworthiness. The arrows indicate which elements of the modeling language are used in the map. Finnish texts are translated in English in boxes with black lines.
APPENDIX 3. A section of the concept map of Pair 2 referring to Mixed Methods, their background philosophy and context of implementation. The arrows indicate which elements of the modelling language are used in the map. Finnish texts are translated in English in boxes with black lines.