Chapter 15
Building Collaborative Ontologies:
A Human Factors Approach

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ABSTRACT

The chapter describes the research performed within the KOMET (Knowledge and cOntent structuring via METhods of collaborative ontology design) project, which was aimed at developing a new paradigm for knowledge structuring. By knowledge structure, the authors define the main domain concepts and relations between them in a form of graph, map, or diagram. The approach considers the specifics of individual cognitive style. Two stages of research have been completed: research into correlations between the expert's individual cognitive style and the peculiarities of expert's subject domain ontology development; and study of correlations between the expert's individual cognitive style and the group ontology design (including the design performed in groups consisting of experts either of similar or of different cognitive styles). The results of this work can be applied to organizing collaborative ontology design (especially for research and learning purposes), data structuring, and other group analytical work. Implications for practice are briefly delineated.

INTRODUCTION

One of the main objectives of the research process is achieving maximal effectiveness from the creation, transfer and dissemination of new knowledge. This effectiveness can be measured by the quality and speed of memorization of the principal concepts of a particular domain and of the relationship between these concepts. Wide evidence exists that the use of visual thinking to address the subject of study is positively connected with the quality and speed of memorization, and thus with the effectiveness of knowledge dissemination. Visualization working as a cognitive tool also facilitates communication within research communities.

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Special interest in such forms of knowledge codification can be observed in education science, especially within learning where the students are engaged in group knowledge sharing and co-creation processes with continuous feedback.

Mutual understanding and mentalization in research is of special interest in collective study or discovery. One of the most productive methods of research collaboration promises to be group ontology design. The specific problem being addressed in this work deals with the problem of improving the quality of group or collaborated ontologies. We are also interested in filling the gaps in understanding the group ontology design process specifics, such as the causes of differentiations between the form and the content of individual ontologies.

This paper presents the main results of the KOMET (Knowledge and cOntent structuring via METhods of collaborative ontology design)) project which was devoted to developing methods of using group visual ontology design in research and education with regards to the respondents' individual cognitive styles. The group ontology design was tested in the medical domain (smaller group) (Gavrilova, Ravodin, Bolotnikova & Kotko, 2012) and computer science (informatics) domain (larger group of participants). All the 79 respondents were graduate students of the School of Computer Science of Saint Petersburg Polytechnic University. Almost all the students had 1-2 years' experience of research in computer science, and were in their fifth year of study on the Masters programme. The preliminary results of this study were partly discussed in (Gavrilova, et al., 2013).

During the last decade, visual knowledge representation has become one of the key considerations in knowledge engineering methodology, and it is strongly associated with ontology design and development. These ontologies, which form a conceptual skeleton of the modelled domain, might serve various purposes such as better understanding, knowledge creation, knowledge sharing, and collaborative learning, problem solving, seeking advice, or developing competences by learning from peers. Recently, the ontological engineering perspective has gained interest in many research domains, such as medicine, business and computer science (Schnotz & Kurschner, 2008; Pfister & Eppler, 2012; Oltramari & Ferrario, 2009; Brochhausen, Spear, Cocos, Weiler, Martin, Anguita & Tsiknakis, 2011). These studies rely heavily on theory and tools from knowledge engineering analysis that already has a long-standing tradition in the knowledge-based systems domain (Mizoguchi & Bordeau, 2000). The largest number of knowledge engineering research articles was generated around the theme of descriptive logics and formal foundations of ontology design (Baader, Horrocks & Sattler, 2005; Kuznetsov, Obiedkov & Roth, 2007).

The tools and techniques developed in this domain can be applied fruitfully in the field of research knowledge structuring and design (Schreiber, 2000; Dicheva & Aroyo, 2004; Dicheva & Dichev, 2005, 2007; Knight, Gašević & Richards, 2006) and semantic web applications (Davies, van Harmelen & Fensel, 2002). The idea of using ontologies and visual structuring in research description and introduction has been discussed in many works (Sherlock, 2000; Fonesca, Davis & Camara, 2003; Brusilovsky, Yudelson & Gavrilova, 2005; Tansley & Tolle, 2009; Diviacco, 2015 (see chapter 19 this book)) and is now being implemented in several research projects and software tools (Bard, & Rhee, 2004; Hevner, 2007).

BACKGROUND OF ONTOLOGY ENGINEERING AND VISUAL KNOWLEDGE MAPPING

This project was targeted at developing a paradigm of data and knowledge structuring with regard to individual cognitive styles, using recent advances in knowledge engineering and conceptual