

## TRIALOGICAL LEARNING IN PRACTICE

František BABIČ, Peter BEDNÁR, Karol FURDIK, Ján PARALIČ, Marek PARALIČ, Jozef WAGNER

Centre for Information Technologies, Faculty of Electrical Engineering and Informatics,  
Technical University of Košice, Letná 9, 042 00 Košice, tel. 055/602 4220, E-mail: frantisek.babic@tuke.sk

### ABSTRACT

In the article presented we deal with an innovative approach to collaborative work and learning. This approach is called *trialogical learning* and has emerged from several theories that describe the creation of new knowledge, e.g. Carl Bereiter's knowledge building approach, Yrjö Engeström's theory of expansive learning based on Activity Theory and Nonaka and Takeuchi's model of organizational knowledge creation. *Triological learning* is not supposed to be a "super-theory" on the basis of these background theories but it pinpoints certain kinds of phenomena which are prevalent and central nowadays: how people organize their work for developing some shared, concrete objects.

*Triological learning* is a relative new approach in education area. Theoretical as well as practical aspects of this innovative learning approach started to be researched and developed in Finland, at the University in Helsinki. From this institution the idea is being distributed now in the (not only) European educational community, e.g. within the KP-Lab project. KP-Lab project presents a unifying view (knowledge-creation perspective) of human cognition based on an assumption that learning is not just individual knowledge acquisition or social interaction, but shared efforts of transforming ideas and social practices.

The KP-Lab team from Technical University of Košice (TUK) is working within the Centre for Information Technologies, Faculty of Electrical Engineering and Informatics, cooperating also with the Faculty of Economics of the same university. TUK is involved in all technological workpackages, playing as such an important role in the technological aspects of the KP-Lab integrated research activities.

**Keywords:** *trialogical learning, collaboration, shared objects, ontology.*

### 1. INTRODUCTION

The research field of collaborative work and its support by information and communication technologies describes an approach, called CSCW (Computer Supported Cooperative Work).

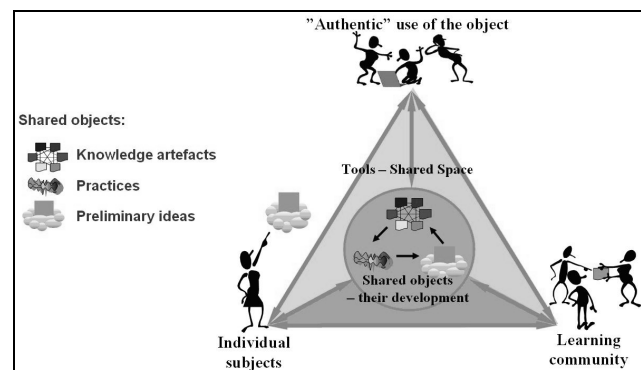
In Slovak high school system, several CSCW/CSCL approaches have been integrated. The most used technologies are Moodle and uLern<sup>1</sup>. Moodle is designed to help the educators to create online courses with opportunities for rich interaction. Its open source license and modular design means that many people can develop additional functionality, and development is undertaken by a globally diffuse network of commercial and non-commercial users. The uLern is the university's online learning environment that provides a framework for a variety of online activities and information that support learning and teaching at the university.

During the last few years, the CSCW has been evolving and extending. Several new topics, e.g. the CSCL (Computer-Supported Collaborative Learning), have emerged. The technological development must react to new requirements from end-users (teachers, students, lecturers, etc.) such as boundary crossing, knowledge creation around shared objects, project-based learning, etc. *Triological learning* includes most of these requirements and for its support it can be researched with existing tools and enhanced by developing new ones.

*Triological learning* is an innovative approach to the collaborative work and learning that provides theoretical background and several technologies to support triological theoretical principles.

*Triological learning* [5] refers to the process where learners are collaboratively developing shared objects of

activity (such as conceptual artefacts, practices, or products) in a systematic fashion. It concentrates on the interaction through these common objects (or artefacts) of activity (see Fig.1), not just among people or within one's mind.



**Fig. 1** How individuals and a community develop shared "authentic" objects [7]

*Triological learning* is not supposed to be a "super-theory" on the basis of these background theories but it pinpoints certain kinds of phenomena which are prevalent and central nowadays: how people organize their work for developing some shared, concrete "objects".

### 2. KNOWLEDGE PRACTICES LABORATORY

It is important to research and develop relevant technologies that support triological learning. This is the main goal of "Knowledge-Practices Laboratory (KP-Lab)"<sup>2</sup> project that presents a unifying view (knowledge creation

<sup>1</sup> <http://ulern.feit.tuke.sk/index.htm>

<sup>2</sup> [www.kp-lab.org](http://www.kp-lab.org)

perspective) of human cognition based on an assumption that learning is not just individual knowledge acquisition or social interaction, but shared efforts of transforming ideas and social practices.

KP-Lab aims at developing theories, tools, and practical models that enhance deliberate advancement and creation of knowledge as well as transformation of knowledge practices. The essential way of developing the collaborative technologies is a co-evolution design process of researchers, technological developers and users.

This integrated project is sponsored by European Commission within the "Sixth Framework Programme" and is scheduled for 5 years. The first three years (from which we are now approaching the end of the second year) are devoted to the research and development of tools practices and theories. Existing and/or newly developed tools are being designed and tested against user requirements in real situations within various pilot cases. The last two years will be devoted mainly to finish longitudinal experiments, dissemination activities and exploitation planning.

KP-Lab technology builds on emerging technologies, such as semantic web, web services, real-time multimedia communication, ubiquitous access using wireless devices, and interorganisational computing. There are also non-technological tools as the change laboratory (the idea is to arrange on the shopfloor a room or space where is a rich set of instruments for analyzing disturbances and for constructing new models for the working practices).

The multinational consortium integrates expertise from various domains, including pedagogy, psychology and engineering as well as end-users and key representatives from the corporate/business sector to provide authentic environments for research and piloting. The project involves 22 partners from 14 countries, as well as many schools, universities, companies and work places and other prospective end-users.

### 3. KP-LAB APPLICATIONS

KP-Lab aims at creating a unified approach to learning in educational and organizational contexts. Such an approach builds on the traditional learning models of knowledge acquisition and participative learning. Its novelty is to consider the learning process from the knowledge creation perspective during the deliberate effort of innovation and transformation of knowledge practices. In order to support this learning paradigm, the KP-Lab platform and accompanying knowledge practices are researched, designed and developed. All the actions performed by users with various knowledge artefacts are mediated by the KP-Lab platform, which is built on a semantic knowledge middleware. This platform offers various novel end-user applications, which are built on conceptual ideas underlying the proposed learning approach, such as collaboration, shared objects, boundary crossing, etc.

KP-Lab system consists of many applications and tools with different purposes and most of them are accessed through a virtual environment, the KP-Lab portal. This is the tool that the end users will see, use and

get accustomed with. The KP-Lab portal provides access to different virtual sites, called Shared Spaces, for multiple user communities such as different universities and companies. The information and applications of the KP-Lab portal may be viewed or used through a web browser. The user environment consists of a set of tools that enable collaborative knowledge practices around shared knowledge artefacts, e.g. Shared Space, Map-It, CASS-Q, SMAT, etc. The most important will be briefly characterised in following sections.

#### 3.1. Shared Space

Shared Space is a virtual collaboration space (see Fig.2) that is meant to support triological learning in higher education or work. In brief, it should support the following aspects: personalisation, temporal and faceted (filtered) views to describe and visualise knowledge artefacts, their associations and state in different arrangements. This allows users to view the knowledge in different manners as well as to work according to the different working practices.

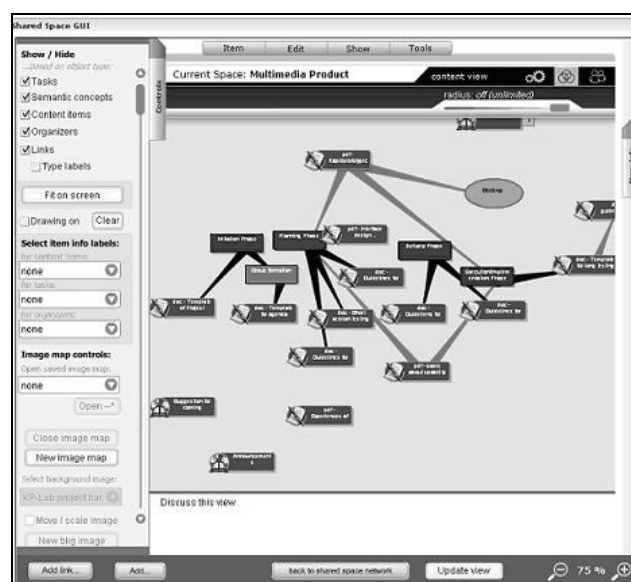


Fig. 2 The KP-Lab Shared Space (pilot course called Multimedia product)

A shared space can be either a personal space or a collective space. The collective space is created for the knowledge community involved in a triological process. Users can browse and access the content of a shared space through the views. A view is a graphical way displaying the structure of information stored in a shared space, e.g. to visualize the relations of knowledge artefacts from different perspectives or the process view is provided for organising the tasks in their timing relations or the content view can be used to access them according to their semantic relations.

The Shared Space provides a set of tools for:

- working with the knowledge artefacts (Content Item service), e.g. for creating, editing, storing, sharing, commenting, annotating semantically using existing vocabularies and/or using users' own tags

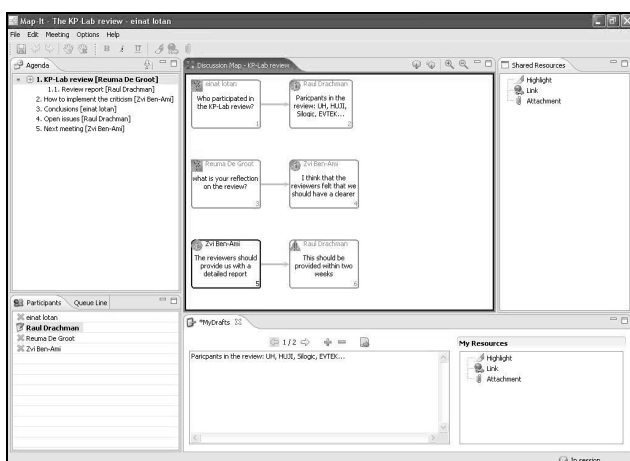
(*Knowledge Annotator service*), disseminating, discussing;

- managing the knowledge processes, e.g. for creating, changing and executing process models (*Knowledge Process service*);
- managing the shared space itself (e.g. configuring the tools available - *Shared Space management*);
- displaying a status information about each user, present and past actions of a user, interaction between users, between users and environment, etc. (*Awareness services*);
- context-based chat;
- visualization of "knowledge objects" through various views (*Graph Data service*);
- semantic and free-text search (*Search service*);
- planning and managing of individual user's work (*ToDo service*).

### 3.2. Map-It

Map-It is, essentially, a software tool aimed at generating in a largely automatic manner a written/graphical record of a conversation. Elaboration of this record can be indifferently made in real-time or in time-shifted manner reflecting oral as well as written exchanges in a conversation. "Conversation", in the present case, stands for any conversation among two or more participants held in a face-to-face or virtual meeting, whether it is asynchronous or synchronous. Typical settings include a professional meeting in a workplace or a teleconference, but many other learning/working settings and usage scenarios are equally possible.

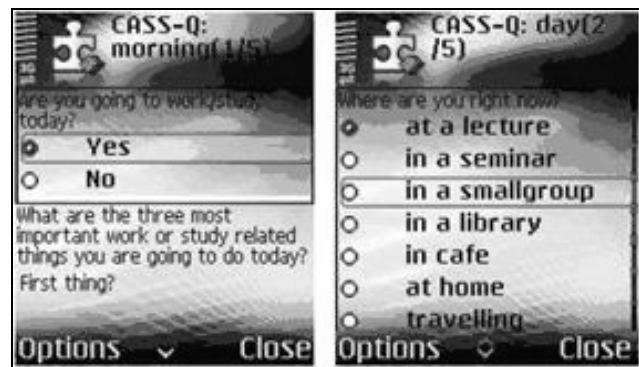
The "record" (see Fig.3) is a map of the conversation, graphically representing the sequence of interventions of various participants and showing, in writing, a portion of the content of those interventions. These long-built graphical maps serve at any time as a reference for the conduction of the conversation. The "conversational moves" can be enriched by the attachment of any additional material, as e.g. audio and video recording (the latter in future versions), links to Web resources, documents and (in future versions) directly the KP-Lab knowledge artefacts.



**Fig. 3** The meeting with the map including all what has been submitted so far (highlighted tab), shared resources, agenda and participants list

### 3.3. CASS

The CASS-query tool is a Java-application for collecting process- and context-sensitive data that supports mobile users. In such a way the valuable immediate inputs from users can be collected and later on processed. The system is implemented on 3G mobile devices (e.g., Nokia N93) with Symbian operating system, MP3, video, GPS, wi-fi. The CASS system provides generalised tools in open-source terms (i.e. adaptable and free of charge) that can, in a flexible way, be tailored and elaborated for the particular needs and requirements of researchers and users.



**Fig. 4** Screenshots from the CASS-query tool

Basic functionalities of the CASS-Query tool include:

- Administrator tool (XML-editor) enables the construction of queries, defining questions and types of responses (open text, Likert-scale, audio- or video recording, picture) (see Fig.4).
- Queries are customizable to each user.
- The application connects to the Internet and downloads the intended query from the server.
- Responses are returned to server database.
- Data are transferable to statistics software SPSS.

### 3.4. Change Laboratory

The Change Laboratory (CL) provides an intervention method for systematic development of working practices. It is based on the framework of developmental work research (DWR), which is based on three basic theoretical ideas. The unit of analysis in the DWR is a collective activity system where the common activity has a specific object. Contradictories solving between components in the activity system brings qualitative changes to the activity and new tools and/or new techniques can emerge in process of deviation analysis. Change and development in the DWR is a long-term collective process during which not just individual mental change but a construction of these new tools, techniques or ways of work can be observed. This kind of learning is called expansive learning [4].

In a typical project, the participants are involved in analysis of their collective activity. This will motivate them to develop and test new solutions for the problems they face in their everyday work. By inspection and

analysis of concrete material from the historical and present development of work participants will construct a “mirror” of their own activity. A generalization of activity system and its components is made by analysis of specific information acquired through this “mirror”. Analyses of historical and present activity lead the working community step forward to the future by forming their own development potential.

The heart of the CL should be the data that are being manipulated with and data that structures other data into specific objects. The Virtual Learning Environment, Virtual White Board (see Fig.5) and Analysis Toolkit are some of examples that can be used to support the DWR.

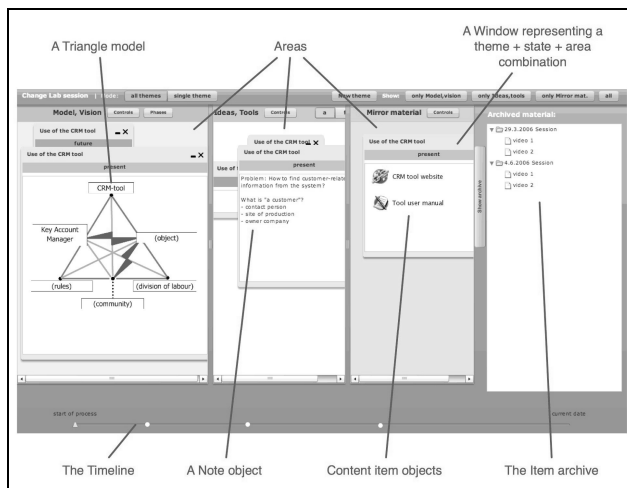


Fig. 5 The Virtual Whiteboard

### 3.5. Semantic multimedia annotation tool

Semantic multimedia annotation tool (SMAT) is a tool that offers the possibility to annotate any multimedia content item. It must be adaptive to the user's business context. This adaptation is based on the use of ontologies to define the type of content item (i.e. video, audio, text ...), the granularity of the content item fragments (i.e. page, image, timestamp ...) and the domain ontology (i.e. actors' activity in a scene, actors' decision, actors' behaviour, object in a scene ...).



Fig. 6 Creating semantic annotations to video clip from medical operation

The annotation consists of observing a content item and adding semantic data. A content item can be seen as a set of clips in which one or several segments are defined. The set of data to be used is usually formally described in the ontology, but it is also possible to annotate with a free text. Practically (see Fig.6), the process of annotation consists of marking fragments into a segment with instances of the data (formal or informal). We consider the ontology as a set of inter-related concepts and constraints describing the business domain. Particular annotations are created in a session. Multiple sessions form a sequence. The sequence is a sort of practical activity or exercise in pedagogical terms. Several ontologies can be used during one session.

## 4. TUK's role in KP-Lab project

The KP-Lab team from Technical University of Košice (TUK) is working within the Centre for Information Technologies<sup>3</sup>, Faculty of Electrical Engineering and Informatics, cooperating also with the Economical Faculty of the same university. TUK is involved in all technological workpackages, playing as such an important role in the technological aspects of the KP-Lab integrated research activities.

We build on our experiences with knowledge technologies, e.g. knowledge discovery from databases [8] as well as textual documents [3], [9]. This is needed particularly for semi-automatic annotation of various textual sources (e.g., learning objects) to concepts from various ontologies as well as e.g. for mining activity log files in order to support personalization and discovery of new working patterns.

Special tools for information extraction from knowledge artefacts and their interconnection with existing conceptual maps are being developed. The user interface will enable interactive construction and management of ontologies. We take the advantage of the tools provided by FORTH<sup>4</sup> to build a flexible repository of semantic descriptions of knowledge artefacts and relevant ontologies. Modern declarative query and modification languages [6] enable the access to stored metadata.

The ultimate goal is to process free or structured content of knowledge artefacts, to build basic conceptual structures, to extract lexical-semantic patterns based on statistical analysis and syntactic patterns, to automatically merge obtained data and update the KP-Lab domain ontologies. The processing includes fundamental NLP (natural language processing) tasks – tokenization, morphological tagging, and the analysis of surface syntax [11].

Several main TUK tasks can be identified:

- Knowledge Process service
- Gateways to Content Repositories
- Text-mining services
- History (log) based awareness
- Persistence API

<sup>3</sup> <http://www.tuke.sk/fei-cit/index-a.html>

<sup>4</sup> <http://athena.ics.forth.gr:9090/RDF/>

#### 4.1. Knowledge Process Service (KPS)

KPS provides a set of features and interfaces necessary for creation, management, and annotation of knowledge processes composed from various elements. It is integrated as web service into the Shared Space. Some of the KPS functions are the following:

- Create, view, update and reuse such process elements as Task, Milestone or Deliverable.
- Set-up description of the element – metadata. For example: name, actor, starting and ending dates for a task, etc.
- Set-up relationships between process elements. For example: prerequisites mean tasks that need to be completed before actual task will start.
- Execution of a process: User can follow current state of a process by defined timeline.
- Change elements setting on the fly: User can flexibly make changes in description of relevant elements based on her/his user rights.
- Process templates will be implemented in the next phase of project.
- Structure of the full process is visualized as Gantt chart.

The basic structure of the knowledge processes is modelled through process ontology [1] that is part of the KP-Lab system model. This system model is stored within the RDFSuite (knowledge repository), which has been developed at FORTH-ICS (Institute of Computer Science, of the Foundation for Research and Technology – Hellas) in Greece. RDFSuite consists of the Validating RDF Parser (VRP), the Schema-Specific Data Base (RSSDB) and an interpreter for the RDF Query Language (RQL). Interpreter for RDF Update Language (RUL) is still under development. RDF Parser (VRP) is a tool for analyzing, validating and processing RDF schemas and resource descriptions. The RDF Schema-Specific Data Base (RSSDB) is a persistent RDF Store for loading resource descriptions in an object-relational DBMS by exploiting the available RDF schema knowledge.

#### 4.2. Gateways to Content Repositories (G2CR)

G2CR aim at specifying, designing and developing the application programming interfaces (APIs) of the KP-Lab for using external content management systems (gateways). They offer an unified way to work with content for KP-Lab tools, which need to build the knowledge artefact abstraction level and so synchronise the access to knowledge and content repositories. The gateway services (see Fig. 7) implement the means for referencing the actual content, based on the assumption that KP-Lab tools shall be capable of exploiting existing external resources, commonly used by the targeted users.

KP-Lab content repository stores contents of knowledge artefacts created with end-user tools. G2CR enable to choose between several digital repository implementations for default content repository and offer the possibility to easily switch between them. Any external content repository supporting that interface will

be easily exploitable in KP-Lab as well. Besides that, gateways tools will allow to use other types of repositories as external source of content.

Examples of tools that G2CR would like to address are Moodle, Alfresco, Plone, Sakai, etc., and at a more atomic level, office documents produced through Microsoft and Open Office tools.



Fig. 7 Content Transfer Module 2.0 on-line demo

#### 4.3. Text-mining services

Text mining and extraction services are designed to assist users in the process of creating or updating the semantic descriptions of KP-Lab knowledge artefacts. The semi-automatic generation of these descriptions or even of new KP-Lab ontologies relies on the textual information attached to particular artefacts as a textual content itself, or as a set of text-based metadata.

Although the knowledge artefacts can be stored in various forms (e.g., textual documents, conceptual maps, video sequences, images, etc.), they often contain textual information directly in its content, or indirectly in metadata or textual annotations given by users. The textual description is analysed using various natural language processing methods and text mining techniques [11]. As a result of the text mining analysis, relevant concepts from the KP-Lab ontologies are suggested to the users during the process of formal description (i.e. annotation) of knowledge artefacts. Text mining services will employ the GATE<sup>5</sup> infrastructure and the JBowI library [3] as an implementation platform. The web interface of the console for maintenance of text mining resources, settings, and algorithms is presented on Fig. 8.

The fundamental tasks for the envisioned text mining services are concept map creation, clustering, and classification of knowledge artefacts [10]. Classification groups a given set of artefacts into predefined or ad hoc categories. Concept map creation automatically extracts significant terms from textual resources and converts them to a structure of concepts and their relations. In addition, KP-Lab tools can also use the derived text mining tasks, such as keyword extraction/ summarisation and information extraction, in order to create an initial dictionary for ontologies or to extract values of various metadata properties.

<sup>5</sup> General Architecture for Text Engineering, <http://www.gate.ac.uk>

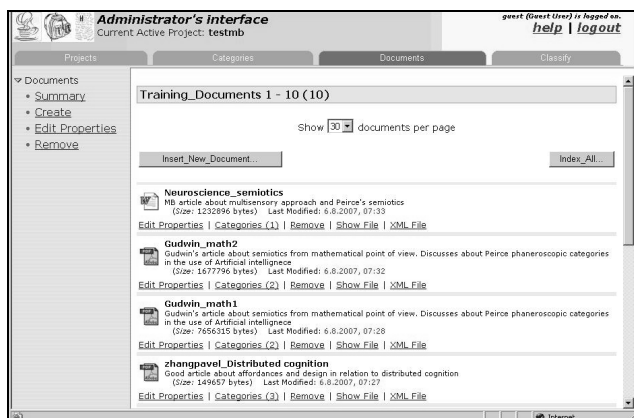


Fig. 8 Prototype of the Mining Engine Console

#### 4.4. History (log) based awareness

History (log) based awareness is an asynchronous functionality that builds on persistent storage of events representing activities performed by users of various end-user tools and based on them supports analysis and discovery of knowledge from previous activities. The results can be used as inputs for the design of the tools, content and GUI adaptation for personalization.

This module [2] is based on generic log storage and query service to which every end-user tool will send various high-level events. Tools will define these events, because tools know what type of actions are important and may be useful to be logged and analyzed to infer knowledge from the actual working practices later on.

We will provide two levels of awareness information from this module. The first level will give answers to basic questions as:

- When each member has logged in lastly?
- Recent changes: Knowing who made what changes to which object, when?
- What kinds of resources (internal or external) students have used?
- A list of all activities that the members have done (not only in actual session).
- Who is the most active/responsible user? ...

In cooperation with other services developed in KP-Lab [10] and utilization of artificial intelligence techniques (e.g. various data mining techniques: clustering, association rules, etc.) following advanced (second level) analyses capabilities will be provided. Various statistics and graphs reflecting selected activities in the system from different points of view, present graphical view (maps) that show how the participants are related to the shared artefacts as well as to each other, discovery of interesting patterns within sequences of actions, and possibly others.

#### 4.5. Search service

Semantic search allows to find KP-Lab object of activities or agents according to the structured metadata, i.e. according to the references to related artefacts, user(s) or shared space(s), metadata that user can define as

formatted item (i.e. numbers, dates), or choose value from a predefined list - vocabulary/ontology vocabulary.

From the user point of view, the KP-Lab semantic search adopted the faceted search interface, which will allow specifying both semantic (i.e. structured) criteria together with the unstructured queries formulated as the free-text.

Search folders are created by saving the query for the semantic search and allow user to execute the same query and store the query result. When the user will open such a folder, Shared Space will send the query associated with this folder to the Search service and present the search result as the content of the folder (the list of items in the folder is dynamically updated).

#### 4.6. Persistence API

Persistence API is a client library used for managing all Knowledge repository (RDFSuite) tasks: Generating RQL/RUL and persisting/fetching of data from repository.

The Persistence API provides the generic RDF persistence framework, which allows serialization and deserialization of the Java objects into RDF repositories (based on RQL and RUL languages). Beside of this, Persistence API will provide Criteria API, which will allow creating and executing RQL queries dynamically in the program code.

One of its main purposes is to separate business logic from RDF. By simple annotations, user can connect his/her Java Bean class with RDFSuite, without knowing RQL/RUL.

#### ACKNOWLEDGMENT

The work presented in this paper was supported by the following projects: the KP-Lab project, which is supported by European Commission DG INFSO under the IST program, contract No. 27490 and RPEU-0011-06 project "Support of Knowledge Creation Processes" supported by the Slovak Research and Development Agency.

The KP-Lab Integrated Project is sponsored under the 6th EU Framework Programme for Research and Development. The authors are solely responsible for the content of this article. It does not represent the opinion of the KP-Lab consortium or the European Community, and the European Community is not responsible for any use that might be made of data appearing therein.

#### REFERENCES

- [1] Babič, F., Wagner, J.: Modeling of knowledge creation processes based on Activity theory, Workshop on Intelligent and Knowledge oriented Technologies 2006, Bratislava, Slovakia. pp. 131-134, ISBN 978-80-969202-5-9.
- [2] Batatia, H. et. al.: Tacit knowledge in KP-Lab, KP-Lab public deliverable D6.3, October, 2007.
- [3] Bednár, P., Butka, P., Paralič, J.: Java Library for Support of Text Mining and Retrieval, In: Proc. of the 4th annual conference ZNALOSTI 2005, Stará Lesná, 2005, pp. 162-169.

- [4] Engeström, Y.: Learning by expanding: An activity-theoretical approach to developmental research, Helsinki: Orienta-Konsultit, 1987.
- [5] Hakkarainen, K., Paavola, S.: From monological and dialogical to triological approaches to learning, A paper at an international workshop "Guided Construction of Knowledge in Classrooms", February 5-8, 2007, Hebrew University, Jerusalem, 2007.
- [6] Karvounarakis, G., Magkanaraki, A., Alexaki, S., Christophides, V., Plexousakis, D., Scholl, M., Tolle, K.: RQL: A Functional Query Language for RDF, In: The Functional Approach to Data Management: Modelling, Analyzing and Integrating Heterogeneous Data, LNCS Series, Springer-Verlag, 2004.
- [7] Lakkala, M., Muukkonen, H., Paavola, S., & Rämö, E.: Pedagogical Design for Triological Approach on Learning. From dialogical learning to triological learning: Knowledge practices in higher education and teacher training. Symposium conducted at the 12th Biennial Conference for Research on Learning and Instruction (EARLI), Budapest, Hungary, 2007.
- [8] Paralič, J. and Bednár, P.: A Tool to Support of the KDD Process, In Journal of Information and Organizational Sciences, Varaždin, Croatia, Vol. 27, 2003, pp. 15-27.
- [9] Paralič, J. and Bednár, P.: Text Mining for Document Annotation and Ontology Support, A book chapter in: "Intelligent Systems at the Service of Mankind", Ubooks, Germany, November 2003, pp. 237-248.
- [10] Smrž, P. et al.: Specification of the SWKM Knowledge Evolution, Recommendation, and Mining services, KP-Lab public deliverable D5.3. September, 2007.
- [11] Smrž, P., Paralič, J., Smatana, P., Furdík, K.: Text Mining Services for Triological Learning. In Proc. of the 6th annual conference ZNALOSTI 2007, Ostrava, Czech Republic, 2007, pp. 97-108, ISBN 978-80-248-1279-3.

Received November 11, 2007, accepted January 30, 2008

## BIOGRAPHIES

**František Babič** graduated (MSc.) at the Department of Cybernetics and Artificial Intelligence of the Faculty of Electrical Engineering and Informatics at Technical University of Košice in 2005. Since 2005 he is working as an internal PhD. student with the Department of Cybernetics and Artificial Intelligence in Centre of Information Technologies, common workplace of Institute of Informatics Slovak Academy of Sciences in Bratislava

and Technical University of Košice. His scientific research is focusing on knowledge management, knowledge discovery and project management.

**Peter Bednár** received his Master degree in 2001 by the Technical University in Košice. Since 2005 he is working as a researcher in the Centre of Information Technologies, common workplace of Institute of Informatics, Slovak Academy of Sciences in Bratislava, and Technical University of Košice. His scientific research is focusing on the areas of text mining, knowledge management, semantic technologies, programming (Java), eGovernment, and knowledge discovery.

**Karol Furdik** (\* 1970) received his Master degree in 1993 and his Ph.D. degree in 2003, both by the Technical University in Košice. Since 2007 he is working as a researcher in the Centre of Information Technologies, common workplace of Institute of Informatics, Slovak Academy of Sciences in Bratislava, and Technical University of Košice. His scientific research is focusing on the areas of natural language processing, text mining, knowledge management, semantic technologies, and eGovernment.

**Ján Paralič** received his Master degree in 1992 and his Ph.D. degree in 1998, both by the Technical University in Košice. Since 2004, he is associate professor at the Department of Cybernetics and Informatics, Technical University in Košice and since 2005 also head of the Centre for Information Technologies at the same university. He (co-)authored two books, (co-)edited 10 proceedings from various international workshops and conferences and published more than 70 scientific papers. His research interests currently are in the areas of knowledge discovery, text mining, semantic technologies, and knowledge management.

**Marek Paralič** received his Master degree in 1995 and his Ph.D. degree in 2002, both by the Technical University in Košice. Since 1996, he is assistant professor at the Department of Computers and Informatics, Technical University in Košice and since 2006 also researcher at the Centre for Information Technologies at the same university. His research interests currently are in the areas of distributed programming, agent-based technologies and service-oriented computing.

**Jozef Wagner** received his Master degree in 2005 by the Technical University in Košice. Since 2005 he is working as a researcher in the Centre of Information Technologies, common workplace of Institute of Informatics, Slovak Academy of Sciences in Bratislava, and Technical University of Košice. His scientific research is focusing on the areas of semantic technologies, programming (ISO C++, Java) and web pages.