Knowledge Practices Environment and Tools for Collaborative Knowledge Creation

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Abstract – **The paper presents the Knowledge Practices Environment (KP-Environment or KPE for short), a web-based collaborative environment offering various facilities for individuals and groups to interact with knowledge artifacts, as well as other users. The environment provides a coherent set of tools in order to initiate and organize collaborative processes, to support asynchronous and synchronous communication among participants, and to create, work on, share, and organize documents collectively. Basic features, architecture, implementation and supporting tools are also outlined.**

Keywords – **Collaborative learning, virtual environment**

I. Introduction

A fundamental challenge for modern society is to organize work with knowledge in a way that supports the shared efforts of innovation, that is, collaborative efforts for developing novel objects like commercial products, scientific theories, and new forms of working or technology. The current approaches of working with knowledge in educational and workplace settings are still focused on individuals' skills and knowledge structures (knowledge acquisition) on the one hand, or on social and cultural interaction (participation) on the other hand. Recent developments in modern society provide deep challenges for higher-education and workplace learning. The rapidly growing body of scientific and professional knowledge as well as dramatically changing work-practices call for new pedagogical approaches suitable to prepare students but also practitioners to actively participate in a knowledge-based society. While traditionally higher education and workplace learning have been aimed at making students acquainted with the up to date body of domain-specific knowledge as well as state-of-the-art practices, today's students and employees are more and more asked not just to interpret the information provided but to make active use of and contribute to the creation of new knowledge.

In parallel with changes in society, conceptual frameworks, practices in school and at work, and social organization of learning also have to be transformed to facilitate development of corresponding individual and cultural competencies. Towards this end there is a need for new methods but also tools which support both students as well as practitioners in sustained efforts of innovation and knowledge creation and social participation around shared objects of activity. While current information and communication technologies are quite capable to support various kinds of knowledge intensive work, the majority of learning technologies, such as learning platforms or virtual learning environments, in common use today, are focused on the management and delivery of learning resources. These kinds of environments, which basically reify the needs and structures of higher education institutions [1] are focused on teacher-driven activities and hence limiting students' options for creative and self-organized participation. They offer only limited support for collaborative practices, typically tools for information sharing and for participation in social interaction. For collaborative work users are provided typically only with a storage space where users can simply upload and file documents. The few existing applications that support specific models of knowledge creation processes are of limited use because of their inflexible and monolithic software design. The documents produced by these tools remain isolated in the system, or even within the organizational structures reflected by the system, without support for explicating and describing relation between them and without support for sustained development. Furthermore, these systems are usually closed entities and access rights are often determined by organizational constraints rather than by groups' needs.

Real knowledge advancement and knowledge creation is a long-term process in which progress takes place through series of inquiry cycles. The challenge is to design an environment that supports such long-term work besides individual courses or projects. To answer this challenge we present the KP-Environment as an innovative collaborative environment aimed to promote knowledge creation and continuous work around shared artifacts. Tools supporting document centered collaboration, managing and analysing complex knowledge structures, as well as networking and community building tools are also outlined. The KP-Environment and tools are currently under development in the Knowledge-Practice Laboratory (KP-Lab) project [2] funded by the European Commission.

II. Aims and Basis Ideas of the KP-Lab Project

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 in educational institutions and professional organizations.

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The KP-Lab project focuses on creating a learning system aimed at facilitating innovative practices of sharing, creating and working with knowledge in education and workplaces based on so called trialogical approach on learning and working [3].This approach builds on the assumption that learning is not just individual knowledge acquisition (monological) or social interaction (dialogical), but activity is organized around transforming, or creating shared knowledge objects.

The essential way of developing the collaborative technologies is a co-evolution process of researchers, technological developers and users. The design principles are as follows: 1.Organizing activity around collaborative advancement of knowledge artifacts: 2. "Symmetric knowledge advancement" around authentic problems; 3. Deliberate transformation of knowledge practices; 4. Co-evolution of tools, social practices, and agents.

The successful implementation of the KP-Lab knowledge practices requires software tools that support spatially, socially and temporally distributed participation in knowledge creation processes and draw on the potential of emerging semantic web technologies. While many core technologies of the Semantic Web infrastructure are already available, there is vast amount of work ahead in tuning them for the use of ordinary learners, instructors and professionals, especially with regard to performance, stability, and usability.

The general objective of the technological research and development is to design and implement a modular, flexible, and extensible ICT system that supports the KP-Lab pedagogical methods to foster knowledge creation in educational and workplace settings. The system need to provide tools for collaborative work around shared objects of activity and for knowledge practices in the various settings.

III. The Knowledge Practices Environment

The Knowledge Practices – Laboratory System (KP-Lab system) is a modular, flexible, and extensible system with a cluster of interoperable applications to foster collaborative knowledge creation. The user environment is a virtual “shared space” and set of tools that enables collaborative knowledge practices around shared knowledge artifacts. Shared spaces can be used either individually or in cooperation with others. Collective spaces can be formed around a group of people belonging to e.g. a project team, students attending a class, students of a university department, or any other type of collective. Groups can assign resources and tasks to specific members and are provided with real-time information about activities of other users that are online at the same time. The technology builds on emerging technologies, such as semantic web, real-time multimedia communication, ubiquitous access using wireless devices, and inter-organisational computing.

The Knowledge Practices Environment (KPE) (Fig. 1) is a central application in KP-Lab system and most of the other end-user applications are integrated into it. It is designed to provide specific affordances for joint development of shared objects as well as organizing related tasks and user networks and interactions. KPE is a virtual environment that includes a set of integrated tools and functionalities for working with the shared knowledge objects. User groups can create shared working areas called shared spaces (ssp). The shared knowledge objects can be visualized and searched in various ways to enable smooth collaboration around the created knowledge in shared spaces. The environment provides users with flexible means to create and modify shared objects (such as documents, task descriptions and other knowledge artifacts) as well as to organize them visually according to different perspectives. Users are able to provide context-related semantic annotations for resources as well as their interrelations. Furthermore, the KP-Environment provides advanced search-facilities as well as tools for collaborative editing of documents and process management.

A. Basic Features

The following is a list of core features implemented in the current release of the KP-Environment [4]:

- *Visualization of Resources:* Users can arrange and organize various types of content items but also task descriptions and their relationships visually. Besides process-, content-, and community-oriented perspectives, which are available by default, users can also create customized views, which allow selecting and organizing a subset of resources available in a given Shared Space.
- *Adding and Linking Content Items within Shared Spaces:* Users can share and link various content items within a shared space. Content items can be files uploaded by user, web links, wiki pages as well as notes, directly created within the shared space. When linking content items users can choose from a predefined set of link types.
- *Commenting Resources:* Users can add comments to all items available within a shared space e.g., content items as well as tasks. Users can also respond to previous comments, hence creating a resource-centered discussion thread.
- *Semantic Tagging and Search:* In addition to the commenting users can also annotate resources either with user defined tags or concepts provided by one or more vocabularies associated with the shared space. Respective search facilities allow to find corresponding sets of content items, tasks or collaborators and hence to systematically explore the resources available.
- *Process Planning:* Shared space provides a set of functions and interfaces necessary for creation and management of knowledge processes composed from various elements, such as tasks and milestones. In order to coordinate collaborative efforts both tasks and content items can be assigned to a user and responsibilities as well as timelines can be defined.
- *Note Editing:* The user is provided with a simple text editor for direct creation and editing of notes within a shared space. While notes can only be edited by one user at a time, multiple users can read a note simultaneously. The Note Editor provides an easy to use tool to produce short notes, draft ideas as well as simple documents.
- *Asynchronous Collaborative Editing of Content:* In addition to the Note Editor, KP-Environment also provides access to an integrated Wiki in order to support the group in producing more complex and structured text documents in an iterative manner.

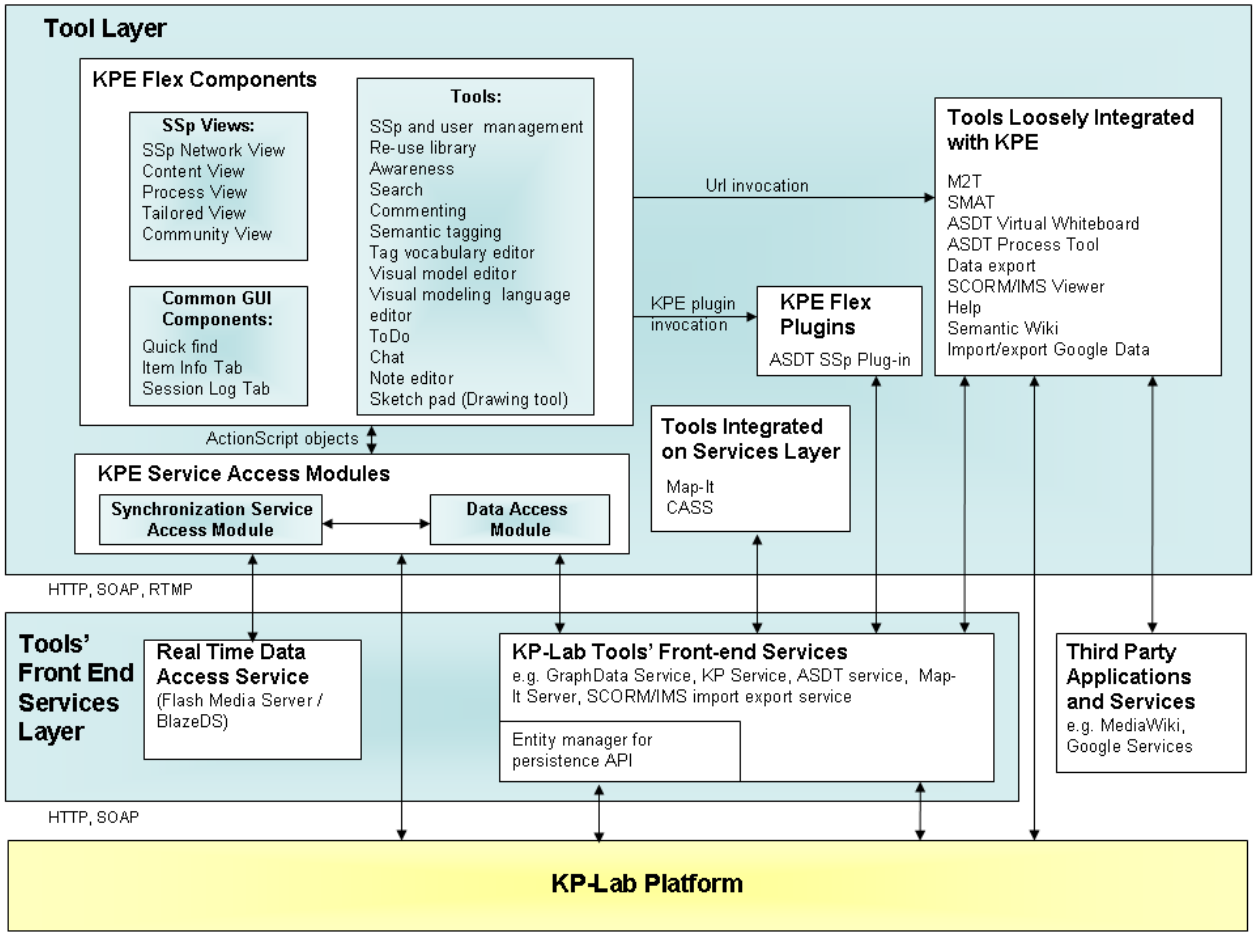

FIGURE 1 KNOWLEDGE PRACTICES ENVIRONMENT APPLICATION ARCHITECTURE

B. High-Level KP-Environment Architecture

The high-level implementation view of Knowledge Practices Environment architecture, i.e. the major technological parts of the KPE and their connections, is illustrated in Figure 1. The architecture consists of three separate parts: the tool layer, the tools' front services layer and the KP-Lab Platform.

Tool layer is composed of KPE's client side components (*KPE Flex Components*, *KPE Service Access Modules*, *KPE Flex plugins*), of *Tools Loosely Integrated with KPE*, and of *Tools Integrated on Services Layer*.

Tools' front end services layer is composed of *KP-Lab Tools' Front-end Services*, *Real Time Data Access Service* (provided by the Flash Media Server and BlazeDS server) and *Third Party Applications and Services*.

KP-Lab platform provides common services to KPE and stand-alone tools. Examples of services provided by the platform are data persistence as well as user authentication and authorization.

The end-user functionality is implemented using Flex (v2.0.1), which is a framework for developing Flash applications. Synchronization and real-time awareness across tools is implemented using Flash Media Server. The server-side modules of KP-Lab Tools are implemented as Web Services. The integration between KP-Lab Tools and other tools is implemented using Java script on the client side and HTTP and SOAP on the server side.

The platform provides pure technical facilities such as gateways and libraries for content management, real-time conferencing and multimedia management platform, as well as software services that are more oriented towards shared functional needs (help material handling, search, participation and history-based awareness). The Semantic Web Knowledge Middleware (SWKM) is the part of the platform that specifically addresses the knowledge management services. The SWKM aims to facilitate knowledge creation processes by supporting advanced interactions of collaborating learners and professionals with knowledge artifacts (i.e. discovery, access, evolution, recommendation and mining).

IV. TOOLS IN KP-ENVIRONMENT

The KP-Environment provides an integrated set of tools. These tools are Rich Internet Applications which are typically composed of a GUI part and a server side front end services. The server part provides the business logic services of the tool, such as saving a new semantic tag to the knowledge repository. The tools rely on a set of platform services implemented as a flexible service oriented architecture that facilitates the integration and interoperability of KP-Lab tools.

Following an ontology-driven approach the functionality of the tools is defined in the Trialogical Learning Ontology (TLO), an RDFS ontology stored in a shared knowledge repository. In addition to the TLO the KP-Lab Tools use a

range of domain specific ontologies in order to accommodate to the needs of different user groups and context. KP-Lab project develops also specific semantic tools for e.g. collaborative semantic modeling and semantic multimedia annotation. These tools are designed to integrate with the Knowledge Practices Environment. 3rd party tools, such as Semantic Wiki, Calendar, Real-Time Collaborative Editing, will be integrated with the environment in Web 2.0 mash-up style using a JavaScript Connector module that is used as a bridge between KP-Environment GUI and the tool.

The tools are developed in co-design processes between theoretical scientists, pedagogical researchers and technological experts, based both on the principles of "trialogical" approach on learning, previous research, and evaluation of existing tools. From functional point of view tools are considered as common, optional, support and stand-alone applications.

Common tools refer to the tightly integrated tools of KPE, which are available inside a shared space for working with knowledge artifacts. Examples are tools facilitating document centred collaboration for writing of simple text objects (*Note Editor*) [5] or drawing (*Sketch pad*) as well as for communication within a Shared Space to facilitate user interaction in a contextualized manner (*Chat tool*). The *Note editor* supports quick brainstorming and production of ideas together and allows viewing, editing versioning, comparing and printing of shared documents in flexible manner. The *Sketch pad* enables easy in-context drawing to support brainstorming and externalizing ideas that are sometimes hard to explicate by only using verbal means. *Chat tool* [6] aims to facilitate networking and community building through contextualized synchronous user communications when working on shared objects.

Optional tools are loosely integrated applications that can be selected by the user to be available in a shared space. An optional tool opens directly into the KPE GUI or into a separate browser window. Examples are Visual Modeling (Language) Editors [7] dedicated for managing and analyzing complex knowledge structures

Support tools provide generic supplementary functionality used in/by the Shared Space views and the other tools, such as awareness, help and search.

Stand-alone applications are used separately from the KPE. KP-Lab platform provides common services to all KP-Lab tools, such as data persistence and authorization.

All implemented features are used for easy idea construction and elaboration and help in collaborative knowledge creation and facilitate reflection of shared knowledge and practices.

V. Conclusion

The paper presents the KP-Environment, a virtual space aimed to promote collaborative knowledge creation and continuous work around shared artifacts. The environment makes use of recent Web 2.0 and Semantic Web applications and provides a coherent set of tools in order to initiate and organize collaborative processes, to support asynchronous and synchronous communication among participants, and to create, work on, share, and organize documents and artifacts collectively.

KP-Environment is aimed to support both students as well as practitioners in their working and learning activities. The prototype and set of tools described in the paper are currently in use and under evaluation by several academic and professional partners throughout Europe and show promising results. Especially KPE flexibility, generic structure and integration of different tools for use, without loosing the semantics and metadata of the shared object under work, make it applicable to a broad range of pedagogical and professional scenarios.

Future design activities include the integration of more advanced features for process management, facilities for collaborative semantic modeling, and integrative usage of tags across the different tools.

VI. Acknowledgement

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