CROKODIL - a Platform for Collaborative Resource-Based Learning

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Abstract. On-the-job learning is primarily a personal knowledge acquisition process accomplished increasingly based on resources found on the Web. These days, collaboratively learning from and with others on the Web is taking on a very prominent position in this learning process. CROKODIL aims to provide support for collaborative learning based on web resources. In this paper, we introduce our learning scenario and an evaluation of our target group. We describe our pedagogical concepts, and present the results of an evaluation of these concepts. CROKODIL supports the semantic tagging of resources as well as the collaborative use of these resources and their information. Social networking functionalities are integrated in the platform to encourage and support collaborative learning. We also present some extensions to the base functionality of the platform, such as resource recommendations and interfaces for the integration in existing learning management systems.

Keywords: Resource-based learning, Collaborative learning, Social networks, Web resources, Recommender systems

1 Introduction

Knowledge acquisition is a lifelong process which has to be continuously performed due to rapidly evolving knowledge bases and the fast development of new technologies. In the last ten years, searching for information via the Internet has become a very important way to keep oneself up-to-date. On-the-job, there is the need to constantly find out more about certain topics or to look for solutions to current problems which someone else might have already solved. In many cases, there are no completely didactically worked out learning objects or learning courses available which could equip the learner or worker with the knowledge needed to complete said task. A shift from the pure form of instructional learning to the more flexible resource-based learning [1], which focuses more on problem solving and critical thinking, is needed. As a result, knowledge acquisition is increasingly accomplished by utilizing resources found on the Web such as open learning content from an educational institution (like iTunes U[1]) or user-generated content like on YouTube[2] or Slideshare[3] as well as collaboratively constructed resources such as wikis and blogs [2]. Besides using and generating content, learners collaborate with other learners using different applications like social networks, discussion boards, wikis or forums. They ask questions, discuss answers, share documents, or recommend resources on certain subjects, which were found to be helpful, to other learners. The advantages of communication and interaction in communities and social networks can no longer be ignored as a very important part of the learning process [1].

This paper is organized as follows. Section 2 explains advantages and challenges of collaborative resource-based learning. Section 3 summarizes existing approaches to address these challenges. In Section 4, we introduce four different learning scenarios which we analyze to determine the requirements for our platform. The results of an exemplary study of the target groups are presented. The pedagogical concept and its evaluation are demonstrated in Section 5. In Section 6, we present the CROKODIL platform, describing its different elements and extensions. This paper concludes with an outlook on future work.

2 Advantages and Challenges in Resource-Based Learning

As mentioned in the introduction, resource-based learning offers many advantages when compared to traditional instructional learning. Rakes [2] shows that learners prefer to learn through interactions with various learning resources rather than through instructional teaching. Studies performed by [3] have shown that learning with web resources highly depends on the personal situation, preferences and previous knowledge of the learner as opposed to the learner's type. Especially for users who actively aim to organize their learning process, the usage of web resources and services from the so called Web2.0 in addition to or in place of traditional learning approaches is helpful.

However, resource-based learning poses challenges for learners both from a technical as well as a pedagogical perspective: There often is no teacher who structures the learning process and prepares the learning material. Additionally, resources on the Web are rarely created by the authors with the intent of creating learning material. The learners, by themselves, have to assess the trustworthiness of the resources and select a variety of these resources which are relevant to their educational goals. Hence, learners have to perform the entire learning process in a self-directed manner. This competence to learn autonomously on the Web cannot be

[1] http://www.apple.com/education/itunes-u/, Online 2011-03-29
[2] http://www.youtube.com/, Online 2011-03-29
[3] http://www.slideshare.net/, Online 2011-03-29

taken for granted. “Learning to learn” is one of the eight key competences listed in the European Commission Reference Framework for lifelong learning [4]. It means the ability to pursue and persist in learning, to organize one's own learning, including the effective management of time and information, both individually and in groups. Therefore, people have to be trained in this kind of learning in educational institutions. In such educational institutions, which are predominantly characterized by instructional learning, collaborative resource-based learning should be integrated in the form of episodes. Such episodes could be small, like a learning task in which learners have to research online in order to answer a specific question, or large when learners perform an extensive research, like an independent preparation of a complex thesis.

Furthermore, learners have to manage different tasks in the overall process of resource-based learning in addition to the actual reading and learning process. Amongst other challenges, learners have to phrase search terms, select relevant web pages from search results and organize and structure web pages they have found for later usage [5]. The technological challenge therefore, is to support the user in all the processes he has to perform in addition to the actual learning of the content of web resources. Our overall goal in CROKODIL is to support all these tasks in one platform.

3 Related Work

Traditional systems for technology enhanced learning mainly focus on the support of the organization of institutional learning scenarios as in different kinds of Learning Management Systems (LMS), or of collaborative learning as in various Computer Supported Collaborative Learning applications (CSCL) or in the management of different tools used in personal learning as in Personal Learning Environments (PLE). For resource management in resource-based learning learners usually use different tools. A survey we performed [6] has shown that learners use search engines, word processing tools, memos or browser bookmarks. So far, social bookmarking platforms like Delicious[4] or reference management programs for research articles like Citavi[5] or Mendeley[6] are rarely used. The authors in [7] give an extensive review of nine different social semantic bookmarking systems: BibSonomy[7], SOBOLEO[8], Fuzzzy[9], GroupMe![10], Twine[11], ZigTag[12], Faviki[13], gnirz[14] and Annotea[15]. These systems allow

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4 http://www.delicious.com/, Online 2011-03-29
5 http://www.citavi.com/, Online 2011-03-29
6 http://www.mendeley.com/, Online 2011-03-29
7 http://www.bibsonomy.org/, Online 2011-03-29
8 http://tool.soboleo.com/, Online 2011-03-29
9 http://www.fuzzzy.com/, Online 2011-03-29
10 http://groupme.org/GroupMe/, Online 2011-03-29
11 http://www.evri.com/, Online 2011-03-29
12 http://www.zigtag.com/, Online 2011-03-29
13 http://www.faviki.com/pages/welcome/, Online 2011-03-29
14 http://code.google.com/p/gnizr/, Online 2011-29-03

the user to add annotations to resources by tagging, rating or commenting. Each system, however, implements these features differently and a different emphasis is given to the degree of automated support offered to the user. Two examples of tagging and annotation systems applied specifically to the learning scenario are OATS (Open Annotation and Tagging System) [8] and FolksAnnotation [9]. OATS is an open-source tool supporting learners in collaboratively creating and sharing knowledge using highlights, tags and notes in HTML based learning content. FolksAnnotation is a semantic metadata tool for annotating learning resources using folksonomies and domain ontologies. These tools however lack pedagogic support for the learning process and only support isolated steps of resource-based learning.

In the CROKODIL project[16] we aim to provide a holistic solution. We therefore develop pedagogical and technological concepts to support collaborative resource-based learning. We integrate these concepts in a novel learning platform and are thus providing support for all the different tasks which are part of collaborative resource-based learning.

4 Target Group Scenarios and Evaluation

Resource-based learning does not only take place in a personal setting outside of educational institutions. It is rather necessary to introduce this form of learning even within educational institutions and provide the students with the skills needed to learn autonomously with resources from the Web. Resource-based learning is thus integrated into the overall instructional setting and thereby gains a new and different scope. Resource-based learning can be implemented as a short episode like answering a question posed by the lecturer or as a longer episode, for example during the preparation of an elaboration on a specific topic. To expedite the use of resource-based learning in educational institutions, we couple the CROKODIL platform with a learning management system. This allows institutions to integrate resource-based learning in the traditional instructional learning process, as well as providing access to content and resources from an LMS in resource-based learning. In the CROKODIL project educational institutions are involved in the design and the evaluation of the new platform: IBB (Institut für Berufliche Bildung) and Siemens Professional Education. Both institutions implement two different scenarios which are described briefly in the following. For two scenarios, we report on an initial target group survey.

4.1 Target Group Scenarios

Scenario 1: Re-education in Information Technology (IBB)

The first scenario is the provision of further education in information technology to people out-of-work. These learners are generally between 25 and 46 years of age and already have some work experience. They receive one-day tasks from the lecturer,

[15] http://www.annotea.org/, Online 2011-03-29

[16] http://www.crokodil.de, Online 2011-03-29

which they accomplish independently by using textbooks and resources found on the Internet. CROKODIL will be integrated in this daily self-directed learning process.

Scenario 2: Education Program for School Dropouts (IBB)
The second scenario encompasses an educational program for school dropouts to support them in finding apprenticeship vacancies. Therefore, in addition to this education program, the trainees partake in internships and classroom trainings. The classroom training day is usually held in an instruction-oriented manner where teachers hold teacher-centered lessons combined with exercises and tests. In this scenario, a continuous use of the CROKODIL platform is hardly reconcilable with the existing rigid learning structure as described above. Thus an episode-based approach to resource-based learning is planned. Short and concise phases of resource-based learning will be integrated into the existing learning procedure. A possible CROKODIL episode in this case could encompass trainees researching in a group on a certain topic and presenting their findings later on to the class later on.

Scenario 3: Bachelor of Arts in Business Administration + Industrial Clerk (Siemens Professional Education)
The participants in the third scenario are pursuing a Bachelor's degree in Business Administration in combination with a commercial vocational qualification (as an industrial clerk). As part of their vocational training, they have to give papers and presentations on various business subjects. The preparation of these papers is mostly self-directed. The title and the content structure, however, have to be agreed upon with their trainer. The target group is divided into two subgroups, each consisting of 10-15 students. CROKODIL will be used in this exploratory learning process to access and manage various internal company resources (e.g. Siemens libraries, intranet resources, Web Based Trainings (WBTs), e-Books) and publicly accessible web resources.

Scenario 4: Bachelor of Engineering + Electronics Technician for Automation Technology (Siemens Professional Education)
In the last scenario, the participants are pursuing a Bachelor's degree in Engineering in combination with a vocational qualification (as an electronics technician for Automation Technology). At present, the learning content is communicated via lectures, tutorials and Computer Based Trainings (CBTs). The degree of self-directed learning could be enhanced by the use of the CROKODIL platform and the integration of additional publicly accessible resources could also be advantageous.

4.2 Target Group Assessment for Scenario 1 and Scenario 2

In order to get a better picture of the target group of the platform and to judge the background of the users regarding resource-based learning, self-regulated learning and their experience with social communities and Web 2.0 tools, we conducted an initial target group survey with the trainees from scenarios 1 and 2. From Scenario 1, we evaluated 15 participants: 14 male, 1 female, with an average age of 32.8 (SD 7).

For Scenario 2, we evaluated 11 female and 7 male participants, having an average age of 18.7 (SD 1.6). Most of the survey items were rated using a 5-point Likert scale ranging from 0 (never) to 4 (almost always). Table 1 shows some selected results.

All participants of the survey are intense web users, going online once or several times a day and feeling quite confident handling this medium. Both groups predominantly use the Internet at home. For the learners in Scenario 1, the most popular internet activities are private surfing, email, online shopping and education related activities. However, most participants as well oftentimes use the Internet during re-education measures (avg. 3.4, SD 0.63) as the primary means for searching information with respect to re-training tasks (avg. 3.7, SD 0.46). For the school dropouts of scenario 2, internet based communication services like email, instant messaging and social networks are a lot more prominent.

Table 1. Selected results of the target group survey.

		Scenario 1		*Scenario 2*	
		Mean	SD	Mean	SD
Which tools do you use for researching information?	Search engine(s)	3.9	0.258	3.7	0.594
	Wikipedia	3.1	0.516	2.2	0.981
	Portal(s)	1.2	0.802	0.9	1.125
	Specialized databases	2.0	1.177	0.2	0.775
Which browser functionalities do you use?	Bookmarking	2.2	1.568	1.5	1.506
	Browser History	2.1	1.387	1.7	1.047
	Add-ons	2.4	1.500	1.5	1.356
Which services do you use for communication with colleagues or co-learners?	Email	1.7	1.345	1.3	1.073
	Phone	2.0	1.309	2.9	0.957
	SMS / MMS	1.0	1.195	2.9	1.023
	Instant Messaging	0.7	0.816	2.6	1.057
	Social networks	0.8	0.775	2.9	1.023

The participants from Scenario 1 show a heavy reliance on search engines and Wikipedia when browsing the Web to find relevant information. Portals and specialized databases are however rarely visited. Some participants also mentioned community related bulletin boards/newsgroups as valuable sources they sometimes refer to. The participants in Scenario 2 almost exclusively rely on search engines and to some extent Wikipedia as well. Expert groups or specialized databases are not used at all. With respect to organizing and re-finding relevant web resources, some users regularly make use of bookmarking and the browser history. For some users, we observe an interesting pattern between these two browser functionalities. Users, who frequently bookmark resources, less often resort to their browser history and vice versa. Tagging is however not a very common practice. Half of the users in Scenario 1 do not know the term tagging and only a few infrequently tag pictures, videos or web resources. In Scenario 2, only 30% are familiar with tagging. Those who are, use tagging frequently, in particular for pictures.

From our evaluation, YouTube, Facebook[17] and its German variants MeinVZ[18]/StudiVZ[19] are the most popular social networks. However, only a small

[17] http://www.facebook.com/, Online 2011-03-29

number of users actively use these platforms on a regular basis. For those who do, the former two social networks are mainly used for communication with close friends and acquaintances. There are some significant differences between the two target groups with respect to social networking. In Scenario 1, communication with friends or colleagues/co-learners within such social platforms is still rare compared to more traditional media like telephone or email. YouTube, on the other hand, serves as a source for finding interesting content. On the other hand in Scenario 2, Facebook and its German counterpart MeinVZ are used by almost all respondents; more than half of them frequently visit these sites to communicate with friends, acquaintances and co-learners, to publish content, to stay up-to-date and to give recommendations. This can be most probably explained by considering the age difference between the two groups, where the participants in Scenario 2 have a lower average age.

5. Pedagogical Concepts and Evaluation

As mentioned in Section 2, there is a pedagogical challenge regarding collaborative resource-based learning - competences in self-regulated and resource-based learning have to be imparted to learners. The aim of the CROKODIL platform is to mediate these competences to the learners. To complement this, a tutor will help with task formulation and tracking attendance in an institutional setting.

5.1 Pedagogical Concept

The central pedagogical elements in CROKODIL are *activities*. The definition of activities should be the starting point for each learning process within the platform. Additionally, the recurring inspection of an activity is the main means for reflecting on the learning process. Activities are basically used to organize tasks often set by a tutor, or to structure goals users wish to accomplish within their learning episode. Activities have the following features and characteristics [10]:

- Activities generally possess a name and a description.
- Activities can be structured hierarchically, i.e. an activity can have sub-activities and super-activities. This helps the learner in identifying sub-steps in a task and structuring it accordingly before starting the work on the task itself.
- An arbitrary number of resources can be allocated to an activity.
- Users can describe their experiences, ask for help or discuss various aspects with other users in form of a dedicated discussion thread.
- An activity can be worked on collaboratively e.g. by adding other users or groups to the activity.
- Activities often result in documents containing the outcome of the work on the activity.

[18] http://www.meinvz.net/, Online 2011-03-29
[19] http://www.studivz.net/, Online 2011-03-29

5.2 Evaluation of the Pedagogical Concept

We organized a one-day workshop with the learners from Scenario 1 (see Section 4) to evaluate the pedagogical concept before implementing it in the first prototype of the CROKODIL platform [10].

From the 32 participants of the re-education program, two working groups were formed: an experimental group of students who were briefed on our pedagogical concept and would apply this concept during the workshop day, and the second group who were not briefed and would be using the usual form of learning. Both groups received a task description from the tutor and were instructed to solve this task on their own by applying prior knowledge and researching for resources on the Internet. The experimental group was instructed to follow the pedagogical concept, i.e. to define and structure activities which are needed to solve the given task. In addition, they were told to document which web resources they used for the activities and which experiences were made while working on the activities. Half-way through the day the members of the experimental group presented their intermediary results in order to receive corrections and guidance regarding the correct implementation of the pedagogical concept. At the end of the day both groups presented their final results.

The evaluation of the observed process and the results show that the experimental group assesses working with the pedagogical concept as a very positive and valuable experience. Especially the reflection process and the formulation of the relevant activities were found to be very important. From our observations, in the short time-frame of the evaluation, the experimental group was able to understand and apply the main didactic components of the pedagogical concept. A weak point, however, was the structuring of the activities in the different sub-activities. We gathered that more support functionality or explicit instructions are needed from either the system or from the tutor to help the users work more effectively and efficiently. These observations confirm the suggestions made by the European Commission in [4], regarding the need for learners to acquire competences for self-directed learning. Our didactic concept already caters for this by allowing the tutor to define appropriate guidelines even before the session starts. The tutor can create activities in the system which the learners can then extend with their own sub-activities.

6. The CROKODIL Platform

6.1 Overview

As mentioned in Section 2, learners have to manage different tasks in the overall process of resource-based learning in addition to the actual reading and learning process, the CROKODIL platform supports the learner in these tasks. Of crucial importance in resource-based learning are the resources from the Web, which are used by the learner during the learning process. Working with the CROKODIL platform, the learner can search for resources on the Internet and receives support in storing, describing and sharing resources which seem interesting for the present activity. In addition to searching on the Internet, the learner can also search through the resources stored by the learning community on the platform. Potentially relevant resources are recommended to the learner.

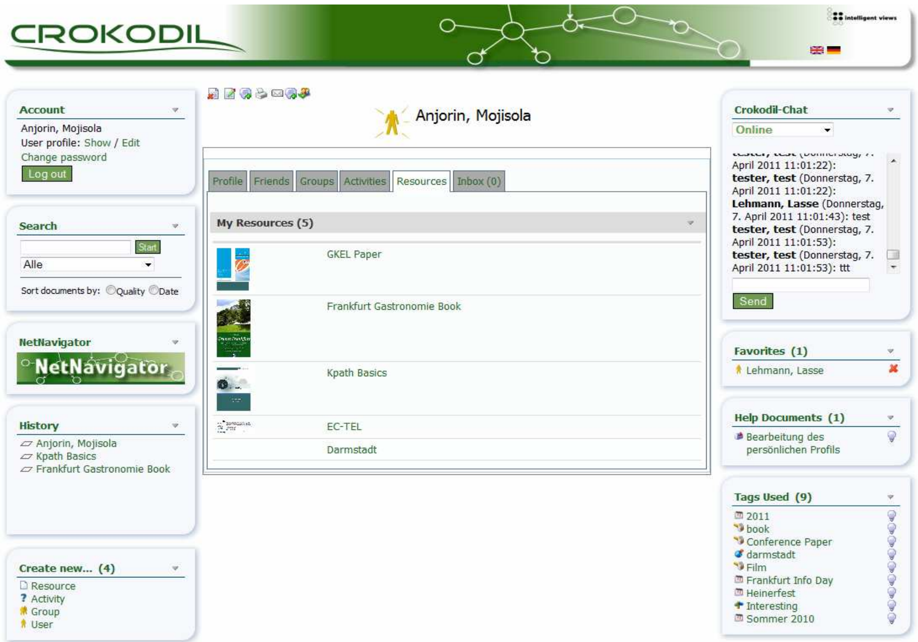

Fig. 1. The CROKODIL Web Portal showing the tab *Resources, th*e other tabs show the user's profile, friends, groups, activities and message inbox. The user can also take part in the online chat. The tags used are listed on the right-hand side for easy and quick access.

Resources in the platform are stored, annotated or described in an easy fashion on the platform as learners can simply tag these resources. CROKODIL enables users to add a concept type to each tag, which allows them to explicitly depict the concept they have in mind. This concept of semantic tagging is described in [11]. Based on an analysis of possible tag types used in resource-based learning, a type set that contains topic, person, learning activity, event, location, type, and a plain tag (i.e. a tag with no specific type attached) was implemented. The tags and resources are represented in the data model as a node, whereas the assignment of a tag to the resource is represented as an edge between them. Between a user and the nodes (which could be resources or tags), a relationship is created. A complex knowledge network is thereby formed. We use K-Infinity[20] as a management platform including all components for building semantic networks. We access and query the semantic network via a web based front-end and we have integrated external data sources. K-Infinity supports different knowledge processing steps ranging from the simple definition of complex

[20] Intelligent Views: http://www.i-views.de, Online 2011-03-29

knowledge models, to the central and local maintenance of knowledge structures, to the use and distribution of available knowledge.

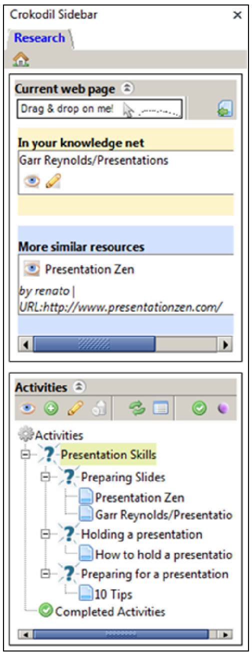

Fig. 2. The CROKODIL Firefox add-on that is integrated as a sidebar in the Firefox browser. Snippets of a web page are dragged and dropped on to the sidebar and these are attached to the activated activity. Similar resources are recommended as well.

For the collection of resources and tags and for copying parts of a web resource (called snippets) as a description of the resource, we developed an add-on for the Web browser Firefox, as shown in Fig. 2. Alternatively, the user can use a custom web application, the CROKODIL web portal, to add resources and information about the resources, as shown in Fig. 1. In the portal, the user can also search for tags or tagged resources, and can view all stored resources.

The portal not only offers support for the management of resources, it also allows the creation of a social network of learners. Each learner has a profile and can create friendship relationships with other users. Users of the platform can also form study groups. These social relationships extend the knowledge network. To support the collaboration among the students, capabilities for synchronous (text chat) and asynchronous (personal messages or discussion threads) communication are integrated into the platform. In addition to these basic functions more features are implemented in the platform. These are now described in more detail in the following sections.

6.2 Implementation of the Pedagogical Concept

The components suggested in the pedagogical concept presented in Section 5 have been implemented in CROKODIL [10]:

- A new tag type "activity" has been defined. Resources found during a learning activity can be tagged with this activity. These resources are thus assigned to this activity.
- Activities can be described by various attributes. Of crucial importance is the attribute "result document". This allows the learners to store their own documentation of the learning outcome of the activity.
- Activities can be organized hierarchically by the relation "is part of activity" and its (inverse) relation "is parent activity to". This allows the structuring of complex activities.
- Each activity provides a text box to document the learner's experiences. Comments to these experiences can also be added. All contributions are shown as a list of text sections showing the user's name, the date and the time of creation.

6.3 Recommender Services in CROKODIL

The relations between tags, users and resources as described in [12] are analyzed and based on the information gained from the structure of the semantic network, recommender services are given to the learner. Recommendations of resources based on semantic similarity between textual resources are also possible. The algorithms applied are presented in [13]. Complementing structural and content-based approaches for personalized recommendations, we will also experiment with knowledge propagation along the social network of CROKODIL users. Social connections are of relevance, since they convey additional user information about interests, tastes or preferences. Moreover, studies indicate that especially in taste-driven domains like music or books familiarity with the person generating the recommendation is appreciated by users and may lead to more precise recommendations [14,15]. However, sociological findings imply that not all members of a network are equally useful, but the different kinds of ties hold different potential, especially regarding the novelty and reliability of information [16].

A first step is to assess the strength of ties in our learner networks. Interactions between CROKODIL learners in form of direct communication or learning group membership will be combined with indirect evidence such as bookmarking, viewing or copying another user's resources. Together with preference information about tags, resources and activities as well as structural information about the local social graph, different kinds of ties (like support, influence) and their strength will be identified. Those ties will be exploited to propagate relevant information and to recommend experts.

6.4 Integration in Social Networks and Learning Management Systems

In order to enrich user profiles within CROKODIL, as well as to increase external visibility of our platform, we plan to integrate CROKODIL with social networks which are popular to our target group according to our questionnaire (see Section 4). We will import relevant user profile attributes, user related metadata like tags and resources; as well as social connections and group memberships. Such external information spares the user from filling in profiles multiple times and, more importantly, to model our users and the ties among them more precisely, e.g. by determining on how many other platforms pairs of friends interact. Facebook offers, for example, FacebookConnect as a way to integrate user information into one's own website. It can also be used to publish on a user's Facebook newsfeed, so friends become aware of activities within CROKODIL.

Besides, Web 2.0 tagging platforms like Delicious are established bookmarking systems that already have a lot of user-generated tags for web resources. Thus, to overcome the problem of data sparseness in the early stage, we are fetching popular tags for URLs bookmarked as well in CROKODIL. External tags can be displayed or only be used internally within similarity computations for recommendations.

The CROKODIL platform is currently being integrated with the CLIX[21] Learning Management System. This allows the integration of episodes of resource-based learning within traditional courses and simplifies the transfer of resources between both systems. For example, learners can individually compile a list of resources in CROKODIL, transfer them to the LMS, and then discuss them online within the LMS e.g. which resources to use for a joint presentation. Similarly, resources can be provided by the instructor in the LMS and then transferred by the learners into the CROKODIL platform. The technical integration is realized in two steps. The LMS CLIX is extended to support OpenSocial[22] gadgets. This includes a proposed extension of the OpenSocial specification allowing the upload of documents to the hosting container. A CROKODIL gadget will then be developed that allows a learner to browse his resources in the CROKODIL system. Resources can be displayed as topic lists or in a graphical network view. The learner selects resources from the list and triggers their upload into the LMS. A resource can be a link to an internet page or a document file. In both cases, metadata from CROKODIL, like tags and notes is also transferred. The OpenSocial specification is already supported by many social networks and it can be expected that soon the major LMS systems will support it, too. The CROKODIL gadget can then be simply plugged into these LMSs to integrate them with CROKODIL.

[21] http://clix.de, Online 2011-03-29

[22] http://www.opensocial.org/, Online 2011-03-29

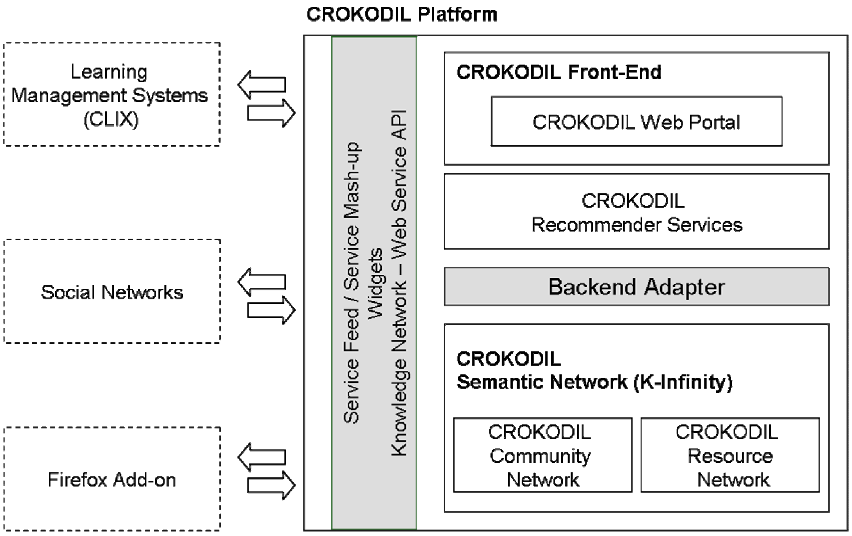

Fig. 3. An overview of the CROKODIL platform architecture showing the most important parts as described in the sections above.

7. Future Steps & Challenges

In the future we plan to implement different recommender systems to inform learners about similar resources from other learners, as well as tags which may be more appropriate for describing the resources. We will investigate and implement relevance ranking measures to improve the searching for and retrieval of relevant resources on the platform. We presently are releasing the first prototype of CROKODIL and we plan to have further releases including these additional technical features.

We also plan to conduct an extensive evaluation of the first prototype of the CROKODIL platform. The scenarios provided by our project partners IBB and Siemens AG will be considered for this evaluation. A comparative evaluation of the different recommender algorithms proposed will show the strengths and weaknesses of each approach; possibly leading to hybrid approaches considering structure, content, metadata, and social behaviour amongst users on the platform.

Acknowledgments
This work is supported by funds from the German Federal Ministry of Education and Research under the mark 01 PF 08015 A and from the European Social Fund of the European Union (ESF). The responsibility for the contents of this publication lies with the authors.

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