Abstract—Currently we see a plethora of learning object repositories that address the need to share learning content with peers within and across educational institutions. We also observe a growing interest in standards and tool functionality to model didactic scenarios describing the social, spacial and temporal configuration of learning arrangements. These scenarios also specify physical resources, software tools as well as communication and cooperation services used thereby. For didactic scenarios, however, possibilities for sharing, reuse and adaptation are currently limited to communities relying on the official standard IMS Learning Design and tools that conform to it and to communities using the same learning activity management tool, e.g., LAMS. The particular contribution of our research is an extensible e-learning environment, edu-sharing, that supports sharing and reuse both of content and didactic scenarios across heterogeneous learning and authoring environments. We illustrate these capabilities through a case study in course design based on a method including the steps: finding, reusing, and adapting predefined didactic scenario templates. These templates representing mature learning arrangements found in literature or best practice experiences contributed by experts. The alignment of learning content with externalized knowledge about educational processes reduces the dominance of content in technology-enhanced learning and emphasizes didactic and social aspects of teaching and learning.

Keywords—didactic scenario template; learning activity modeling; cross-platform sharing; e-Learning portal

I. INTRODUCTION

For many years, research and development on technology-enhanced learning were dominated by the development of learning management systems, virtual environments, and tools for learning support, assessment and authoring of all kinds. Then, the search for proper learning object models and the creation of digital learning content moved into focus.

More recently, the advent of Web 2.0 enabled social networking and brought about new tools and services like blogs, wikis, social sharing spaces, online office tools, video sharing, or podcasting. Instructional designers and teaching staff (e.g., lecturers, tutors, trainers or teachers) quickly embraced them but were challenged to reflect about purposeful learning tasks involving these tools and features. Hence, educators who promote self-directed and collaborative learning have to create specific teaching-learning processes within particular learning scenarios supported by educational media.

Recent approaches to learning with educational media and information systems have reflected this focus on the process of teaching and learning. Research in Computer Supported Collaborative Learning (CSCL) explores how communications services, collaborative tools and social software can be used for learning in groups. Blended learning scenarios lay emphasis on the integration of web-based self-study and classroom teaching. On a theoretical level, learner-centred approaches such as situated learning and social-constructivist learning are discussed. Educators picked up these approaches, not only to deliver educational content, but moreover to encourage students to participate more actively in educational processes.

However, educators may require orientation and guidance in order to create enhanced learning scenarios, e.g. through reuse and transfer of best practice. A common concept for best practice sharing in education is to describe and apply methods for teaching and learning. Notions of teaching-learning methods are manifold: common concepts include lecture, self-study, exercise, discussion, disputation, simulation, case study, problem-oriented learning, learning-by-doing, role-play. Learning management systems usually offer the functionality to design courses based on these methods. However, the features for sharing and reuse of learning scenarios, based on a formal description, are still limited. With edu-sharing, we address this need within a portal for the sharing and reuse of both content and process models for learning. Providing the features for storing, retrieving, adapting and employing learning scenarios, we target knowledge building about educational processes.

An early attempt to promote the idea of formalizing learning processes in terms of activities, roles of players, content, method and metadata dates back to the Educational Modelling Language (EML). EML comprises a modeling language and related authoring tools and runtime environments. It was developed at the Open Universiteit of the Netherlands with the motivation to embed learning objects into a didactic context including student and tutor activities [11]. Maybe because most examples were only available in Dutch, EML passed largely unnoticed by the public at
large. However, core ideas of EML finally flew into the IMS Learning Design (LD) standard [8], [12].

In an earlier phase of our project, we studied the IMS LD standard intensively and experimented with LD editors like RELOAD [19]. Due to usability and performance weaknesses and the limited distribution of LD players, we postponed a decision to support LD in the portal edu-sharing until LD finds a wider acceptance in practice. LAMS (Learning Activity Management System) is diagram-based scenario editors that does not conform to the IMS-LD specification but embodies similar ideas towards activity sequencing [6]. LAMS provides a simple and highly intuitive user interface that allows the course designer to drag and drop typed activity nodes into the edit area and use connecting arrows to organize the activities into a sequential workflow. The activity types are predefined and cover typical classroom activities. Feedback from users of our technology confirmed us in the decision to adhere to more a pragmatic approach to codify learning processes. This pragmatic approach conforms to the working style of educators using Moodle [17] for the specification of learning paths [3].

In this paper, we present a proof of concept study, applying our conceptual approach and technical implementation to the reconstruction of an introductory course module on Social Networking. With this exemplary case study, we illustrate the application of proven learning methods for the enhanced design of the educational process, as the edu-sharing portal supports it. Our exemplary course is currently used in the joint curriculum of a transatlantic university consortium fostering student mobility.

In Section II, we sketch the components and end-user tools of the edu-sharing portal. Section III presents the structure and function of didactic scenario templates. In Section IV, we illustrate how the "workflow" of an educational process is built from within an integrated LMS that provides access to reusable learning objects and predefined scenario templates. We conclude with a brief summary and outlook on future work.

II. PROJECT SURVEY

The portal edu-sharing is an outcome of a four year project, CampusContent [4], that has been funded between March 2005 and July 2009 by the Deutsche Forschungsgemeinschaft (DFG). Edu-sharing provides a rich set of tools that support authoring and learning processes and enable the sharing and reuse of digital learning content and codified teaching-learning processes across heterogenous learning management systems. The heart of the portal is a network of repositories connected with each other through web services.

The distributed repository provides a personal workspace for each registered user and sustainably maintains open or closed content that has been uploaded from the user’s hard disk or workspace or has been created through an authoring activity from within the portal. Workspaces and the facility to invite others to access (part of) one’s workspace, support collaboration among educators within trusted communities of practice. Open interfaces allow different portal operators to connect their preferred authoring tools and learning management systems to the repository network.

A range of special editors and two open source learning management systems (LMSes), Moodle [17] and metacoon [16], are included in the standard distribution of edu-sharing. Plans and agreements with other platform developers exist to interface further LMSes with edu-sharing. The editors allow the production of different types of data representing basic building blocks of learning content, QTI 2.0 compatible assessment questions and tests, and didactic scenarios. The portal also executes teaching-learning processes in the learning management systems integrated.

In addition, the integration of repository and LMSes offers further features besides accessing the repository from within the LMS. They include searching content in the repository, managing content in the personal workspace, linking or inserting a copy of a didactic scenario or learning object found into a course in the LMS, and storing sustainably in the repository. A license management component supports content owners upon upload to associate an appropriate use license with their works in the repository network. The personal workspace of each registered user serves to organize and connect clusters of documents and, more importantly, to share these with others, independent of usage rights and licenses.

The portal builds on the open source content management system Alfresco [1] and the open source portal software Liferay [15]. Currently edu-sharing undergoes a pilot use phase with different kinds of user groups at universities, schools and vocational training institutions. By the end of 2009, the software packages developed in the project will be published as open source software to the public at large.

In [13] we presented innovative methods and a scalable framework for developing and personalizing customizable interactive learning objects. A learning object was defined to consist of three components: information, a didactic micro-scenario and a learning objective. These components are flexibly combined with each other adapting the software design principle “late composition”.

In this paper, we focus on more coarse-grain didactic scenarios specifying learning paths composed of phases that comprise learning, cooperation and assessment activities, references to resources and services or tools to be used in this phase.

III. DIDACTIC SCENARIO TEMPLATES

An innovative contribution of the portal edu-sharing is a rich collection of predefined templates of mature didactic scenarios of different granularity that we adapted from literature. Fine-grained examples of such scenarios include devils advocate, active structuring, flashlight, brainstorming,
concept mapping, think-pair-square, and web-quest. More complex scenarios, which often rely on tool support, include case study, jigsaw classroom, puzzle method, strategic problem solving, or project-based learning. The frequent use of these didactic scenarios along with their description in educational literature allows for a first assessment of their quality. In addition, some of them are evaluated extensively, like case study [5] or project-based learning [20]. For others, quality assurance relies rather on common sense and best practice sharing among educators. For predefined templates, we therefore start from proven teaching-learning methods described in educational literature. However, the edu-sharing portal supports educators to design, share and adapt didactic scenarios. Since edu-sharing fosters domain specific communities of educators, collaborative processes of peer review and rating allow for quality assurance backed by practical experience.

The didactic scenario templates are defined in an abstract form without reference to specific resources and tools to make them applicable to many subject disciplines. They are published in the portal. To facilitate search and finding, these templates are supplemented with appropriate metadata, which have been defined by the project CampusContent. They refer to group size, learning time, or type of educational event (e.g., self-study, lecture, experiment, or self-assessment).

Didactic scenario templates in edu-sharing are codified in a structure that employs key concepts of IMS LD and allows for a pragmatic subset of IMS LD. IMS Learning Design is a specification and conceptual framework in which an educator expresses the flow of activities to be carried out by learners and tutors in an educational process through units of learning. Besides activities and roles, a unit of learning includes references to learning objects, environments, tools, and services to be used in a running process. The specified unit of learning will be run in any LMS with an LD-conform player. The player coordinates the learning and communication activities, provides access to the right resources, and synchronizes interactions between role players.

In edu-sharing, didactic scenario templates are formalized in terms of learning phases. Learning phases represent the concept of "act" in IMS LD. There, multiple acts follow sequentially within a "play", which is a synonym for a certain teaching-learning method. Only within one act, parallel tasks are to be assigned to different roles, while the transition from one act to another applies to all roles. Therefore, acts in IMS LD serve as a synchronisation element and mark phases within a unit of learning. However, the scenario editor of edu-sharing allows for the nesting of learning phases. This allows for a flexible aggregation of didactic scenarios of different granularity.

Structural, informational, social, and didactic aspects of a scenario and learning phase are organized in different tabs, as illustrated in Fig. 1. Templates just distinguish two roles, teacher and learner, while IMS LD allows the definition of arbitrary many roles. Hints for teachers or tutors are summarized in the Teacher Hints Tab. Recommended learning activities are presented in the Student Activities Tab. The Description Tab contains general information such as the didactic intention behind the scenario, the expected value or general hints.

This formalization of didactic scenarios focuses on learning phases, student activities, teacher hints and general information along with learning objectives. In face of the sophisticated information model of IMS LD, the user centred development for the visualization of didactic scenario templates in edu-sharing revealed the named elements as the bare essentials of a formal description for a teaching-learning process. Starting from these essentials, edu-sharing supports educators to take the first step towards a structured codification of their pedagogical intentions. To foster a more detailed formalization of didactic scenarios, other forms of assistance beyond this pragmatic approach are required. However, further research on supportive features should start from these essentials.

In our case study example, the top level Description Tab states that case studies describe authentic situations that students are confronted with in the form of a story and that case studies aim to bridge between theory and practice. The Description Tab of phase Confrontation explains: Once the groups have been organized and informed generally, the case is presented. The intended Learning Objective for a case study may read as follows:

| For a given case, students shall demonstrate their ability to apply theoretical concepts to solve a realistic problem occurring in practice. | Figure 1 | Sections of the didactic scenario template "Case Study" |
|---|---|---|---|---|
| Description | Objectives | Student Activities | Teacher Hints |
| Case Study | | | |
| Case studies describe authentic situations students are confronted with in the form of a story. |
| The length of a case study may vary from a one page description of simple cases to complex cases expanding over 30 pages. |
| Description | Objectives | Student Activities | Teacher Hints |
| Confrontation | | | |
| Disputation | | | |
| Collision | | | |
Advantages including:
- Promoters of case studies claim that a stringent process in the use of case studies can maximize the learning outcome.
- Each student is involved.
- Case studies enable interactive education.

Disadvantages such as:
- Case studies require a substantial amount of preparation and coordination effort on the side of the teacher.

Didactic Requirements such as the case should:
- be true-to-life and realistic,
- have a close relationship to prior experiences of the students and represent a potential situation in the students’ future professional life,
- be open for interpretation from the viewpoint of the student,
- address problems and include conflicts,
- be manageable under the given time constraints, and
- allow more than one solutions.
- Students should also be able to solve it given the individual knowledge and skills.

The Confrontation Phase might specify a more specific learning objective as follows:

The students shall demonstrate that they grasp the relevant content of the case study text by discussing the key problem and conflicts identified with their group, jointly refining the problem analysis, and prepare clarification questions for the tutor, if needs arise.

Teacher Hints would say:

The teacher or tutor explains the general aims, supervises the team formation process, and presents the concrete case to the students. The tutor should be prepared to answer clarification questions raised in the groups.

Individual students follow concrete instances of didactic scenarios to acquire knowledge, skills and competences. Such instances are custom-designed to the actual learning context, e.g., by refined learning objectives and other tab information. In addition, they come with attached resources such as textbooks, references to websites, documents and other sources of information, communication and collaboration tools, and services can be attached to each phase and the whole scenario.

IV. BUILDING A COURSE ON SOCIAL NETWORK ANALYSIS

In this section, we explain how the "workflow" of an educational process is designed and executed with the help of edu-sharing tools and content. We assume that smaller or larger sections of course text including suitable figures, tables and other representational elements have been created by the course author(s) using proper authoring tools. These content elements can then be attached as study material to process steps.

The standard installation of our portal includes, for instance, an XML-based authoring tool that allows authors to save their work in their personal workspace or in the repository network. They can work online and offline. In the latter case, changes made on the author’s computer are updated automatically once they are connected to the portal again. They can include images, pictures, graphics, other multimedia elements and even text passages maintained in their workspace or in the open access repository.

Figure 2. A new option in the embedded Moodle instance to add a didactic scenario

When it comes to design an educational process, edu-sharing currently offers two learning management systems, Moodle and metacoon, that use the same editor and the same player but presented in the style of the actual LMS. Hence, a Moodle user works in her familiar environment, which is just modified in three spots:

1) The pull-down menu to create an activity includes a new option, namely the import of a didactic scenario from the workspace or repository. This extension is illustrated in Fig. 2. The popup window is enlarged for improved readability.

2) Similarly, the "Add a resource" menu of Moodle offers a new option to include resources from the author’s workspace or from the repository. Such resources either can be searched in the repository using its search and filter functionality or it can be uploaded into the repository from an external storage medium and then referenced from within the repository.

3) Course plans or didactic scenarios can be saved as didactic scenario templates in the repository. In doing so, the author can decide which resources of the given course and which services used (e.g., forum, chat, wiki, etc.) will be omitted from the template to allow re-users to add their own choices.
The course Social Network Analysis (SNA), which is depicted in the screenshot in Fig. 2, has been developed by the ICACE project [7], [18] to complement a cross-institutional curriculum on Ambient Computing Education. ICACE represents a consortium of US and EU universities that is funded under ATLANTIS program [2], an EU-US cooperation in higher education and vocational training. Like other projects in this program, ICACE fosters transatlantic student mobility for one semester. It is expected that students develop sustainable relationships to overseas classmates during the foreign semester and that they stay involved in formal or informal learning activities with the remote institution or remote peers after they returned to their home institution. This requires learning scenarios that can be studied in a blended or distant mode. To support these objectives, the SNA course consists of the following topics and phases:

1) "Introduction to Social Networks", which is presented in the form of a webcast by the author.
2) "Cohesion in Social Networks" to be studied in a self-directed learning phase. Corresponding resources include course texts, exercises and a reference to an online tool for hands-on experiences.
3) "Balance Theory", again a self-study phase that leads into network partitioning issues and related theories and algorithms.
4) "Applying Balance Theory to a Case" uses a predefined didactic template, Case Study (see Fig. 1), which the author imported from the repository.
5) "Brokerage" and "Bridge Persons" are two further topics for self-study.
6) The course concludes with an explorative project in which student groups are designing and implementing a web spider to mine a given social network for the top ten bridge persons. To organize this study phase, another well-known didactic scenario, "Project-based Learning", has been imported from the repository and adapted to the needs of this course.

A lecturer in social sciences may find the SNA course and want to adapt it to her student community, which is possible if the license associated with the SNA course admits changes. She may want to change some experiments and exercises that require computing skills and, in particular, replace the case study. Such changes can be easily performed in the scenario editor. During the design phase, she can change roles to preview the student’s or teacher’s view of a learning design.

Instances of both Moodle and metacoon are integrated in the edu-sharing portal. Both use the same engine for editing and running didactic scenario templates. Thus, didactic scenarios developed in one LMS can be run or changed in the other. In addition, this integration is possible for stand-alone instances of Moodle or metacoon. Open and flexible interfaces allow other LMSes to use this engine, too. However, the proposed solution still relies on sharing both the internal representation and the adequate runtime engine. Therefore, LMSes have to be adapted to integrate didactic scenario templates from edu-sharing. In order to overcome this provisional yet applicable solution, we are currently investigating a common model for IMS LD and de-facto standards for the formal description of teaching-learning processes, such as LAMS [14] or the backup format of Moodle. This research aims to promote such a model as a common representation scheme that can be mapped into the different information models. Using the common representation scheme would allow to transform didactic scenarios created in one LMS for the use in another LMS.

V. CONCLUSION AND FUTURE WORK

We presented a comprehensive e-learning portal and methodological foundations that allow educators to relate reusable content with codified best practices in teaching and learning. The motivation behind this work was to overcome the limitations of earlier approaches towards learning object repositories, which largely ignore the didactic context in which learning and teaching context is embedded. Our aim was to create a positive influence on current e-teaching and e-learning practices by encouraging the exchange and reuse of educational resources, didactic knowledge and proven teaching experience. The edu-sharing approach aims to add the following benefits to existing architectures of learning object repositories:

1) Allow for the exchange of didactic scenarios in addition to the reuse of learning materials. This was inspired by the standard IMS Learning Design, which aims at the formalized description of learning scenarios. A pragmatic subset of IMS LD concepts allows for the exchange and reuse best practices in teaching and learning both at the micro level of learning objects, which was discussed in an earlier paper [13], and at the macro level of learning and teaching processes.
2) Become an attractive work bench for the joint creation of course material and course outlines. The edu-sharing web portal facilitates personalized access as well as collaboration in communities of practice among scholars and teachers. It aims to accommodate the daily practice of educators.
3) Address domain specific communities of teaching. Users are expected to group according to disciplines, joint projects or specific interests. These communities allow for peer review, commitment, reputation building and mutual trust. They also provide an essential source for gathering context information.
4) Provide seamless access to the networked repository from the LMS in use. For Moodle and metacoon, a reference implementation is already available. Developers of other platforms are invited to provide interfaces to the edu-sharing network. This integration into
the everyday practice of educators is supplemented by the integration of authoring systems, together with an inbuilt information and help system, concerning both technical issues and pedagogical fundamentals.

5) Reduce the high demands on information security management induced by content licensing, user management, and user data tracking. Edu-sharing supports both open content licenses such as Creative Commons and other forms of licensing, especially restricted access to proprietary content. Educators can provide access for learners to objects in the repository from a course management system based on institutional licenses as well, without transmitting personal data of learners to the repository.

We tried to illustrate some of these intended benefits by a by a proof-of-concept study that was carried out in the context of a transatlantic student mobility project cite-ICACE. In this project our portal edu-sharing and the courses we maintain in it, including teh course on Social Network Analysis sketched in this paper, serve to link students across the Atlantic and accommodate different needs including: pre-classroom preparation in self-study phases, class-room-attendance abroad, and collaboration with peer students both in physical proximity and in distributed settings. Further scientifically accompanied pilot projects at schools and universities are ongoing and planned to evaluate our hypotheses empirically.

After the project CampusContent and its financial support ended, these projects and further community-building and dissemination activities are now coordinated by a new not-for-profit association, edu-sharing, which was founded by leading members of the CampusContent project, by educational software developers and teachers at schools and universities. A core task of edu-sharing will also be the coordination of different stakeholders such as portal users, software developers and service providers, with the former including: content and scenario providers, re-users, and researchers.

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1All online resources were last retrieved December 8, 2009.

