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Workshop Program

	Time	Title	Author(s)
	09:30-10:00	**Workshop Opening**	
	10:00-10:30	**Coffee Break**	
Session 1	10:30-12:30	**Overview**	
		Identification of User's Learning Goals in Workflows [LOKMOL]	O. Rostanin, R. Schirru
		Personal Learning Environments: Challenging the dominant design of educational systems [L3NCD]	S. Wilson
		The User as Prisoner: How the Dilemma Might Dissolve [LOKMOL]	A. Kohlhase
		Discussion	
	12:30-14:00	**Lunch Break**	
Session 2	14:00-15:30	*Socially Aware Informal Learning Support: Potentials and Challenges of the Social Dimension* [LOKMOL]	S. Braun, A. Schmidt
		A Framework for Building Virtual Communities for Education [L3NCD]	I. Varlamis, I. Apostolakis
		Building Lifelong Learning Networks of Teachers for the Development of Competence in Teaching in Small Rural Schools [L3NCD]	P. Koulouris, S. Sotiriou
		Discussion	
	15:30-16:00	**Coffee Break**	
Session 3	16:00-18:00	*Rethinking the Use of Ontologies in Learning* [LOKMOL]	H. Allert, H. Markkanen, C. Richter
		Competence and Performance in Requirements Engineering: Bringing Learning to the Workplace [LOKMOL]	T. Ley, B. Kump, S. N. Lindstaedt, D. Albert, N. A. M. Maiden, S. V. Jones
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1 Introduction

In many organizations most working processes are very knowledge intensive and involve many people working at different locations and on different tasks. The context in which people are working is changing constantly through changing work processes, different tasks or problems to be solved, and evolving technologies which are used at work. These facts require life-long competence development. Competency development takes mostly place during informal learning at the workplace. The learning process is characterized by self-organized activities such as selecting the environment for learning (e.g., Internet), defining learning goals (e.g., related to a work problem), finding and selecting content for learning (e.g., websites or colleagues), and following a preferred learning path.

Beside a continuous formal competence development, sharing knowledge among members of the organizations and making ones knowledge explicit for others is crucial. Working and learning takes place in a network of people, tools, environments, and knowledge. These networks facilitate interaction and communication
The use of available e-Learning and Knowledge Management applications in a network setting can help to address the challenge of continuous competence development.

However, questions arise how these methodologies and technologies of the different domains fit together in order to ensure that the learned can be transferred to the workplace and to improve the performance of each individual? How can we foster interaction and provide a personalized learning experience according to the current situation and context (e.g., flexible guidance for self-directed learning, adaptive content selection and structuring)? How can we better use existing networks for competence development and how can we ensure that learning goals are based on real-world needs? How can we engage learners and actively involve them in the learning process through interaction?

The high potential for synergies between Knowledge Management (KM) and e-Learning seems obvious given the many interrelations and dependencies of these two fields. However, the relationship is not yet fully understood and harnessed. KM addresses learning mostly as part of knowledge sharing processes and focuses on specific forms of informal learning (e.g., learning in a community of practice) or on providing access to learning resources or experts. Current KM technologies focus on knowledge acquisition, storage, retrieval, and maintenance. However, regarding the deployment process, learning is considered to be a fundamental part of KM because employees must internalize (learn) shared knowledge before they can use it to perform specific tasks. On the other hand, e-Learning systems might also benefit from KM technologies. Especially the ones focusing on the support of technical and organizational components can play an important role concerning the development of professional e-Learning systems.

During the last years, so-called Web2.0 technologies, such as Wikis and Blogs, received more and more attention and they are currently used in many different domains. So far, these technologies seem to have a positive impact in terms of community building, knowledge sharing, and content creation - even if their success has not been empirically proven. First questions arise, to what degree these systems (e.g., Weblogs, Wikis, XML/RSS based content syndication and aggregation) support certain learning processes.

This workshop is made out of two different calls for papers. On the one hand, LOKMOL (Learner-Oriented Knowledge Management & KM-Oriented E-Learning), based on the insight that KM technologies need to take into account findings from social sciences such as pedagogy or psychology, to be effective in terms of learning and that learning can profit from KM technologies. In fact, there is a gap between well organized, but monolithic and inert e-Learning material such as courseware on the one hand and dynamic and flexible knowledge bases that are often not able to activate learning processes on the other hand. An integration of KM and e-Learning, especially by using Web2.0 technologies, could dramatically change today's understanding of further education towards lifelong learning fed by dynamically changing public and organizational knowledge repositories. Web2.0 technologies already incorporate the network paradigm of continuous documentation, sharing, and construction of new knowledge.

On the other hand, L3NCD (Life Long Learning Networks for Competence Development), based on the experience of the European projects TENCompentence (www.tencompetence.org) and ProLearn (www.prolearn-project.org). Researchers in the workshop are able to identify and analyse current research and technologies in certain fields in order to support individuals, teams and organisations to (further) develop their competences, using all the distributed knowledge resources, learning activities, units of learning and learning routes/programmes that are available online.

Recent developments clearly indicate a change in the way we acquire and improve our level of expertise in some field or another. Life Long Learning Networks and Competence Development are two relevant topics focusing on continuous education to support new ways to our professional development. Getting some personal competences that provide a good framework beyond the established curriculum is a crucial issue to get and consolidate any professional position. On the other hand, learning networks are an excellent way to acquire and to share knowledge in an informal communication process. The combination of both topics enables the development of tools and methodologies to improve personal competences while, possibly at the same time, contribute to the development of other learners.

The requirements of the models and technologies to support such integrated facilities differ considerably from those traditionally required from technologies that support lifelong learning, or to enable company knowledge dissemination and knowledge management needs. The lifelong competence development of each individual and the multi-institutional and episodic nature of this learning are not reflected in today's mainstream learning and knowledge technologies and their associated architectures.

As a result of these two calls for papers, LOKMOL and L3NCD bring together a common workshop providing a pool of interesting and highly related topics: Professional Learning, Competence Development and Knowledge Management.

2 Workshop Topics

Adaptivity and Personalization

Providing information tailored to an individual’s needs and preferences is a key factor for the success of professional learning. Thus, systems must take into account the current situation and context to be able to deliver an appropriate learning experience. Learner-oriented knowledge structuring and the ability to deliver “just enough” information “just in time” are key technologies to enable such an experience.

Rostanin & Schirru [7] present a method for learning goal elicitation by using information derived from an enterprise workflow management system. Adaptive presentation generation is enabled by using the learning goals to select appropriate content and a learning strategy. Ley et al. [5] use the competence performance approach to support informal learning interventions. In this approach, competencies are used to structure single learning resources according to the underlying knowledge need. Braun & Schmidt [2] give an overview about the potential of “social awareness”, claiming that technological support must become more aware of the social context of the individual in order to be able to provide adequate support.

Collaborative Work and Collaborative Learning

As working and learning often takes place in a network of people and (KM) tools, an appropriate support by these tools can also stimulate learning processes. Moreover, collaboration is facilitated by a lot of social web applications that become more and more popular.

Allert et al. [1] focus on scenarios of ontology-based collaborative learning, while Braun & Schmidt [2] investigate the influence of the social context of a user, e.g., when using an “expert finder” component. Kohlhase [3] addresses the topic of users as consumers and producers using the notion of content collaboration as example for the “Prisoner’s Dilemma”.

Users as Content Consumers and Producers

Nowadays, users are often no longer acting just as consumers of content. User generated content has become more and more important in the recent years, fostered especially by the use of Web2.0 technologies like Wikis and Blogs. These developments do not only support sharing knowledge, but also an active involvement in the learning process. However, there’s still a lack of deeper analysis concerning the success of these methods in different scenarios.

Kohlhase [3] analyzes social tagging as a technique being used very successful in various applications within the Web2.0 context to investigate how users can be stimulated to contribute.

Lifelong Learning Networks and Virtual Learning Communities

Koulouris & Sotiriou [4] research on the use of Long Life Learning Networks in rural environments and show how powerful are and how many benefits the users can take out of it. In doing so, it is needed to establish members’ commitment to the domain, and facilitate community development by assisting them to engage in joint activities and discussions, help each other, share information and learn from each other in a collaborative way, while pursuing their interest in their domain. This will indeed be a community of practice rather than a mere community of interest.

On the other side, Varlamis & Apostolakis [8] address that the gains from the use of a virtual learning community [9] are many for universities and students, as the students have the ability to exchange empirical knowledge while carrying out learning activities and the tutors can increase the consultation time through forums. On the other hand, when communities are in contact with companies, they receive information on new products and reading material, thus promoting professional excellence of educators.

Personal Learning Environments

Wilson et al. [10] state that VLE is clearly the dominant design in educational technology today, and is nearly ubiquitous in higher education institutions. There is a desire to bridge the worlds of formal and informal learning and to realize the goals of lifelong learning by the increasingly prevalent forms of social software and the new paradigms of the web as technology platform. The VLE is by no means dead, and those with investments in this technology will attempt to co-opt new developments into the design in order to prolong its usefulness.

3 Concluding Remarks

In this chapter we reviewed the contributions to the Joint International Workshop on Professional Learning, Competence Development and Knowledge Management. Similar to what we found in the previous LOKMOL workshop [6], these three topic areas can be brought together and even integrated in a variety of different ways. Life-Long Learning is an important task and challenge of the future, both for organizations as well as for the community as a whole. KM and e-learning technologies offer opportunities to master this challenge by contributing and facilitating to continuous competence development in trainings and at the workplace.
In particular, the workshop identified three emerging trends that look promising and that present a number of research questions:

- *User Orientation:* KM technologies provide huge potential for delivering content and information that is tailored to the individual needs of the user or learner. Rather than a one-size-fits-all approach, as frequently adopted in early e-Learning products, the learner should be put into the center of the learning process. User adaptivity and personalization in accordance with individual preferences, learning goals, needs or learning styles might improve the learners' motivation and the learning effect. Individually tailored knowledge chunks delivered in a timely manner offer learning opportunities that would not be available otherwise.
- *Collaboration:* Collaboration in a variety of formats became popular with the adoption of the social web, the so-called Web2.0. For instance, learners collaborate or cooperate in communities of practice as well as for informal or self-directed learning. Social web technologies aim to exploit the power of the social knowledge, by facilitating common efforts (e.g., wikis, blogs) or by providing information about the behavior of peers (e.g., social tagging). A number of examples demonstrate how this can be harnessed for learning. In the context of Life-Long Learning , learners must be enabled to build and maintain communities that are stable enough to provide over-lasting, trust-worthy social contacts, but that are flexible enough to cater for the ever changing learning needs.
- *Activity centered:* Both e-Learning and KM used to be very much focused on content delivery as opposed to learning activities. The recent trend towards richer, interactive content has also been recognized in this

workshop. Explicit modeling of and adaptation of technologies to the learners' activities will make learning at the workplace more natural and effective.

The workshop also stressed again the fact that effective and efficient competence development can be achieved only in an interdisciplinary effort. Pedagogy, sociology, psychology, business administration and computer science can make valuable contributions to this field, but need to learn from each other. We are confident that the workshop represents a step towards this goal by outlining synergies and opportunities for research and practice.

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Rethinking the Use of Ontologies in Learning

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Abstract. This paper investigates the use of ontologies in processes of collaborative learning and knowledge generation. The creation and use of ontologies is analysed from an activity theoretical perspective in order to understand processes of shared conceptualization as well as the role of ontologies in processes of change and transformation. Scenarios of ontology-based collaborative learning and knowledge-creation are presented. This work is based on the cultural-historical activity theory, providing a theoretical framework (1) for understanding processes of knowledge-creation which take place when generating and using ontologies and (2) to investigate the dynamic relationship (coupling) between individual learning and the transformation of a community.

1 Introduction

A fundamental challenge for modern societies is to organize both work and learning in a way that goes beyond the reproduction and use of preexisting knowledge and contributes to the generation of innovative solutions and knowledge, such as new theories, innovative work flows, and advanced technological products. Here, knowledge generation is a common intention of learning and knowledge management. To address this challenge diverse approaches have been developed in the fields of knowledge management as well as in education. These approaches, which can be subsumed under the so called "knowledge-creation metaphor of learning" [21] conceptualize learning and knowing as a social process where people collectively improve their understanding by generating shared knowledge artefacts. As knowledge creation is directed towards the creation of shared artefacts, the development of a shared understanding about the knowledge domain becomes crucial. Therefore the collaborative creation of ontologies and conceptual models lends itself to this task quite naturally. But, while much effort has been spent on the definition of ontology languages and the automated processing of ontologies, the individual and social processes underlying the creation, use, and evolution of ontologies, as well as the potential of ontologies to foster processes of knowledge creation are not yet being studied to its full extent [11].

This paper explores how to utilize ontologies to support and trigger processes of knowledge creation. Unlike in present ontology-based learning applications, we are interested in exploring learning processes where learners collectively advance their individual and shared understanding through social interaction. This work is based on the cultural-historical activity theory as a theoretical framework, capable to explain the generation and evolution of ontologies from a social as well as an individual perspective. Section 2 illustrates the usage of ontologies in education and defines the core terminology. Section 3 gives an outline on the *cultural-historical activity theory* and discusses ontologies for learning from an activity theoretical perspective. Section 4 explores ways to use ontologies in education and outlines several educational scenarios. Section 5 sets up directions for further work.

2 The Usage of Ontologies in Learning

The term *ontology* has generated substantial controversy. As one can find many definitions in the current literature, this paper provides some introductory remarks on terminology and presents how ontologies are used in learning. It explores the status of ontologies from an activity theoretical perspective. Even though they are rarely acknowledged as such, ontologies are a cognitive tool in a wide range of settings where learning takes place. Learners often actively deal with ontologies in learning processes. For example, students learn to read geographical maps. In order to read and understand the map, they have to understand the underlying ontology codified in the different shapes, colors and symbols and explained in the legend. In another setting learners use a basic ontology of argumentation as they learn to analyze an argument distinguishing between a fact, a hypotheses, a question, and a conclusion. In order to find a certain book in the library students have to become familiar with some academic ontologies on scientific disciplines. A project team developing a shared file-system to organize their documents has to agree on a shared ontology. When being asked to describe a certain business process students have to decide and to agree on the concepts relevant to describe such a process. In this work, ontologies are discussed as a concept used in computer science, deliberately excluding other denotations. We refer to the following often used definition: “An ontology is a formal explicit specification of a shared conceptualization for a domain of interest” [14]. An ontology includes a vocabulary of terms, and some specification of their meaning [16]. This includes definitions and an indication of how concepts are related, which imposes a structure on the domain and constrains the interpretations of terms. Ontologies formally define the semantics of concepts and their relations for a specific domain. Ontologies are socially shared artifacts as their generation requires a cooperative process in order to gain a consensual representation of the collective knowledge on the domain [11]. As ontologies arise as a result of cooperation within communities, they are inevitably aligned with a particular perspective on the domain of interest. This perspective defines the *underlying rationale* and *theoretical foundation* of the ontology, irrespective if it is explicitly stated or not. We refer to an ontology as a *conceptual model* and to the underlying theoretical foundation of an ontology as the *meta-model* of the ontology. Ontologies can be represented in diverse languages. While informal ontologies and conceptual models can be described by graphical modeling languages, formal ontologies and their instantiations are usually expressed in formally defined languages. In the context of the semantic web RDFS or OWL (http://w3.org/TR/owl-guide/ and /rdf-schema/) provide such ontology languages.

3 An Activity Theoretical Perspective on Ontology Development

An ontology by definition is a socially shared artefact. It provides a shared understanding of the semantics of objects and their relationships within a certain domain. As shared mediating artefact it is a prerequisite for communication and collaboration within a community. Even though each member of a community might have its own "private" ontology, these personal conceptual models evolve and are shaped in the context of social interaction. Due to the socially shared nature of ontologies, learning theories that focus on individual learning processes fall short to explain the socially shared development of ontologies. Ontologies are created at the intersection of individual learning and the collective transformation of a community. In the following, the cultural-historical activity theory serves as a theoretical framework to explain ontology development from a social as well as an individual perspective.

3.1 The Cultural-Historical Activity Theory

The following is a fragmentary synopsis of the *cultural-historical activity theory*, stressing those aspects that are relevant with regard to the role of ontologies in work and learning. For a more comprehensive introduction the reader is referred to [26], [18], [10]. The cultural-historical activity theory is originated in the works of Vygotsky [26] and extended by Leontjev [18] and Engeström [10]. The theory provides a framework for describing and analysing collaborative processes. In contrast to psychological theories of human action which focus on cognitive processes of the individual on the one hand and sociological theories describing work and activity as merely social phenomena on the other hand, the cultural-historical activity theory stresses the *dynamic interrelation of individual processes and the social context* they are embedded in. It allows explaining the dynamic relationship between individual learning and the transformation of knowledge within a community.

The essential premises of the cultural-historical activity theory can be summarized as follows. (1) Human activity is object-oriented, i.e. it is directed towards a material or ideal object that is transformed or manipulated by the activity. It is the object and not the goal that allows distinguishing different activities from one another. (2) Activities are mediated by tools and signs, which are constitutive elements of any activity system. They are mediating artefacts ranging from physical tools over less tangible artefacts like plans and spreadsheets to scientific theories and languages. Mediating artefacts capture and preserve the socially shared knowledge developed in a community [18], [24]. (3) Human activity cannot be detached form its social context as every activity draws on artefacts which are the result of cultural-historical development. The meaning of an activity is bound to its interpretation within a social context. (4) Learning is an ongoing process of mutual-dynamic adaptation of culture and the individual. By means of an activity, the individual successively opens itself to the scope of options provided by the culture. In turn, culture is created by individuals' activities [20]. Learning is directed towards the co-construction of shared mediating artefacts, e.g. the conceptualization of a shared conceptual artefact. (5) Activity theory is interested in processes and practices that differ from expectations and anticipations as well as deviate from routines and taken-for-granted assumptions [9]. Consequently, it foregrounds breakdowns, conflicts, deviations, discoordinations, disturbances, tensions, and unofficial work-arounds that tend to be explained away by other approaches. These are assumed to be signs of deeper contradictions among the elements of activity system or between interacting activity systems [15]. Activity systems are never static but evolve, e.g. when contradictions emerge between the elements within an activity system or between interacting activity systems. The elements within an activity system can not be detached and isolated from each other.

3.2 Activity Theory and Ontologies

Before we explore the role of ontologies within the context of learning, it is important to clarify the concept of ontologies from an activity theoretical perspective. The mediation of activities is not limited to physical tools but encompasses linguistic, conceptual, as well as cognitive artefacts, including theories, models and languages [24]. Therefore, it is argued that an ontology or a conceptual modeling language also constitutes an artefact capable to mediate human activity. Given the understanding of an ontology or conceptual modeling language as a shared mediating artefact (tool) that can be used to modify or transform a certain object several implications impose themselves. An ontology is by no means neutral, neither to the subject nor to the object of the activity, but is part of the activity system. The ontology used in a certain activity system has an impact on both the subject and the object. Accordingly the utility of an ontology is bound to the object and the subject of the activity and cannot be assessed independently. Secondly, an ontology like any other mediating artefact is the result of a cultural-historical development process within a certain community. As mediating artefacts are objectifications of socially shared knowledge and are build on specific premises it is likely that ontologies not only vary in their terminology but also reflect different theoretical foundations [1]. Thirdly, an ontology can become the object of an activity itself and can be modified or transformed. As ontologies provide powerful tools for organizing and assigning meaning and directly relate to the epistemological foundations held within a community, the analysis and development of ontologies is an important and sometimes drastic intervention. The domain of psychiatry provides an example for the dynamic relationship between individual learning and transformation of a community: Kraepelin's ethiology-based classification system, which is based on the underlying rationale that deceases can be classified according to its causes, has been the first systematic classification scheme in psychiatry (~1900). It forms the basis for the first standardized International Classification of Deceases (ICD). Despite continuous specification and modification inconsistencies became obvious in work practice using the ontology. As the ontology did not well support work practice of individuals, the community reconstructed the ontology and its underlying rationale and now classifies psychological deceases by specifying its syndromes. Changes in the ontology and its theoretical foundation came along with transformation of knowledge in the activity system itself.

3.3 The Role of Ontologies in Knowledge-Creation

The development and use of conceptual models in learning has been a research topic of the learning sciences for many years. While the earlier works focussed on the individual learner, the collaborative use of conceptual models has become a research field in its own later on [19]. Despite the ongoing interest in the use of conceptual models for learning, there is a lack of theoretical as well as empirical work regarding the role of ontologies in collaborative learning and knowledge creation. The following is an attempt to chart uses of ontologies for learning and to sketch respective challenges from a learning sciences point of view. Ontologies (whether explicit or not) provide a common ground for a community. Participation within any kind of community requires familiarity with its (explicitly and implicitly stated) ontologies. Accordingly knowing and applying domain specific ontologies is an integral part of vocational training, e.g. the classification of diseases for a nurse. To become familiar with an ontology does not only mean to recall the concepts and their relations correctly but also to use them as a tool when carrying out an activity. Using an ontology is a challenging tasks for a learner: There is not a single ontology as communities often create and use multiple ontologies which do not necessarily map to each other. Accordingly, the learner has to be familiar with multiple ontologies, be able to mediate between them and to know when to use which one. The competent use of an ontology requires to understand the underlying rationale on which it is built, its theoretical foundation, as well as its historical evolution. In order to grasp the provisional character of ontologies the learner must have developed a sophisticated set of epistemological beliefs himself [5].

Shared conceptual models are never static but are constantly transformed as the activity system evolves. Therefore, it is crucial to treat ontologies as the object of an activity itself. New communities have to construct their ontologies from scratch or have to change existing ontologies due to changing practices. Changing work practices often enforce transforming ontologies. The shared conceptualization of an ontology provides a genuine opportunity for learning for the individual (individual learning) as well as the community itself (knowledge generation and transformation of the community, e.g. organizational and societal learning). The shared conceptualization of an ontology has the capability to provoke cognitive conflicts and helps to unravel prevalent misunderstandings: Processes that can trigger significant learning [22].

3.4 Meta-Models as the Object of Activity

Not only an ontology but also its meta-model and underlying theoretical foundation can become an object of activity. The change of a meta-model and the corresponding underlying rationale and theoretical foundation is associated with transformation and change within an organisation and a community. Knowledge generation takes place in making conflicts and contradictions explicit. Ontologies which are based on conflicting meta-models and underlying rationales can and must not simply be mapped, merged and integrated automatically as they provide the opportunity to generate innovative knowledge as well as organizational and collective learning. This is based on a central principle of activity theory: Conflicts, tensions, and contradictions are assumed to be signs of deeper contradictions among the elements of an activity system (or between interacting activity systems) [15]. The following example demonstrates this: [7] describes the results of an analysis of the formal and informal structure of a huge petroleum organization, depicted by an organigram and a sociogram respectively. Both models are essential to define the problem, to gain insight, to understand the problem, and to propose a solution as each model provides a unique perspective onto the organization. Regarding the use of ontologies this means that learning not necessarily requires mapping and integrating ontologies, but that crucial insights become apparent when incommensurable ontologies based on different meta-models are contrasted. The analysis of meta-models opens up perspectives that go beyond those provided by using a single ontology. The work on meta-models is seen as a profoundly reflective activity tackling the theoretical foundation of a community. Change occurs when a community gives up a certain meta-model and introduces a new one. The comparison of different meta-models allows questioning the theoretical foundation. As the refinement of conceptual models can be seen as a process of successive optimization, changes in the meta-model come along with qualitative changes in the activity system itself. Both, ontologies and meta-models are a means of learning. In this sense the work on meta-models parallels the idea of double-loop learning as proposed by [2].

4 Using Ontologies to Foster Learning

This section explores ways to use ontologies in educational settings. Due to the fact that ontologies provide a socially shared conceptualization we focus on collaborative learning and knowledge creation. Scenarios are presented to exemplify collaborative practises to support ontology-based knowledge creation in education.

4.1 Existing Approaches

Besides one reference [8], a literature review on using ontologies in learning ended without any noteworthy results. Nevertheless there are at least two areas of research on the use of ontology development to foster learning. Even though they are either not explicitly focusing on ontologies (e.g. concept mapping) or do not lend themselves to learning as in the sense of collaborative construction of ontologies, they provide a valuable base to reveal methods for ontology development as a learning method.

Concept Mapping. There are many commonalities between ontology development and concept mapping in terms of learning. Concept maps are used in educational settings e.g. as a technique for teaching conceptual thinking and for externalizing learner conceptualization of a domain [6]. [4] proposes using conceptual models as advance organizers in instructional design. Concept maps can be developed by individual learners to externalize and organize thoughts, providing a means for reflection and for extending the capability to recall things. Concept mapping techniques have also been applied in evaluating students' learning. [6] proposes concept mapping to capture a student's understanding of the ontology of a domain, as well as to infer his/her misconceptions. Concept mapping is used in scenarios of collaborative learning. [12] describes a scenario where individual students have to develop concept maps for a specific domain of interest and link them to associated materials. Peers then assess these maps, modify and enhance them, and provide alternative versions. While many of the tools and methods developed for concept mapping might also be applied in the context of ontology development, there are limitations of current approaches. Based on the examples found in literature concept mapping often is performed as an isolated task, solely focusing on the explication and negotiation of concepts without being embedded within a purposeful activity. This might hinder learners to see the mediating and dynamic nature of ontologies.

Collaborative Construction of Ontologies. As the potential of constructing ontologies as a means to foster knowledge creation has hardly been recognized in education, there is a lack of respective models. Several methods to facilitate ontology construction processes have been developed in knowledge engineering [13]. Ontologies are usually designed by expert knowledge engineers, who are often not aware of the conflicting views of the specific target domain in question (medicine, process management, etc.) and the respective conceptual models held within a specific domain [3]. To overcome this problem proposals for organizing the cooperative construction of ontologies in (distributed) groups of human actors have been made. [3] proposes a three-phased ontology construction procedure consisting of a generation phase (joint brainstorming on relevant concepts), an explication phase (a joint taxonomy is worked out), and finally the integration phase (the proposals are negotiated into a shared conceptualization supported by a human mediator). [17] presents the Human-Centered Ontology Engineering Methodology (HCOME) for the development of dynamic ontologies, which are seen as a means to explicate conceptualizations that are constructed by humans during practice. The approach aims to empower knowledge workers to manage their formal conceptualization in daily tasks through a continuous process. Methods for the collaborative construction of ontologies provide valuable input to the use of ontologies in education. However, the strategies described above fall short with regard to knowledge creation and learning as they do not provide means to foster reflection on the value and role of the ontology.

4.2 Scenarios of Ontology-Based Collaborative Knowledge Creation

The following scenarios present practices to support ontology-based knowledge creation within communities. In the first and second scenario ontologies are used as tools. In the third scenario, the ontology is the object of the activity. The fourth scenario deals with the use of multiple ontologies and their respective meta-models.

Using Existing Ontologies to Carry out an Activity. To become familiar with the ontologies, classification schemas, and conceptual models used in a certain domain or professional community is an important learning objective in many training programs. In order to train the competent use of existing ontologies learners can be assigned tasks that require the use of the ontology to carry out an activity. Students in a course on biology have to classify the plants they found on an excursion. Using an ontology not only requires to know the ontology itself, but also to understand the underlying logic. The task becomes even more challenging when there are different and competing ontologies available.

Using Ontologies to Organize or Annotate Shared Artefacts. Both in project- and problem-based learning students often have to deal with a plethora of artefacts that have to be organized, stored and retrieved during the learning process. Ontologies can be used to sort and classify artefacts relevant to the problem. Students assigned to carry out an empirical investigation conduct a literature review and organize the results according to a shared conceptual model. The need to use ontologies for this purpose grows in relation to the amount of shared documents and the duration of the project. While students might have access to existing reference ontologies, it might also be useful that the students develop an ontology on their own.

Collaborative Ontology Development as Part of an Overarching Task. In this scenario a group of students develops a shared ontology to make sense of concepts and relations relevant to their task at hand. As ontologies are not just externalizations of mental models but have to proof their utility in practice, the process of ontology creation should not be an end in itself but an integral part of a more overarching task. Developing a shared ontology requires a lot of collaborative effort in order to gain an improved comprehension of the domain and how it might be conceptualized. Learners produce networks of linked ontologies and associated resources. The process can become very complex, particularly in long-term advancement of shared knowledge artefacts, a process typical to project- or inquiry-based learning.

Collaborative Inquiry Based on Multiple Ontologies. In this scenario students use multiple ontologies in parallel to solve a problem. Each student develops his/her own conceptual model. Then the students compare their models. A group is encouraged to describe the problem from different points of view using multiple ontologies. A group of students in computer science is asked to conceptualize a problem from a technical as well as a social perspective. In contrast to the development of a shared ontology, the goal is not to merge or map the different perspectives, but to use them to shed light on a problem from different angles.

A prevailing characteristic of this learning scenario is the use of multiple ontologies in parallel. The issue of dynamic and multiple classification, hardly addressed by current conceptual modeling techniques, becomes apparent when multiple domain-ontologies are used to describe a common set of resources. According to [23] the concurrent use of multiple domain-ontologies requires an explicit distinction of contexts. In order to allow for dynamic modeling [25] recommends introducing the concept of *roles* into object-oriented modeling. This approach distinguishes *natural-types* (class-types) and *role-types*. Instances of natural-types can fill and leave a role without losing their identity. An instance of a natural-type can fill different roles in different contexts. According to [1] the *role-*

based modeling approach allows describing coherent and theoretically founded conceptual frameworks and activity systems while at the same time allows semantic interoperability by defining attributes of natural-types.

Ontologies as Meta-Cognitive Tools. The use of ontologies in learning, focusing on the concepts of a specific knowledge domain (typically the nodes in a node-arc-node diagram) often sticks to learning facts. It lacks to support the development of meta-cognitive skills, such as the competence to carry out research, comprising argumentation, inquiry, and knowledge generation. Meta-cognitive tools comprise e.g. an ontology of argumentation and an ontology of progressive inquiry. Ontologies which specify different types of knowledge are integrated in tools like Belvedere and the Future Learning Environment (FLE3), but are not explicitly stated as such. The use of an argumentation ontology is depicted in figure 1.

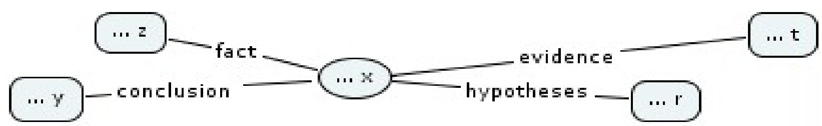

Fig. 1. An argumentation ontology which helps to develop meta-cognitive skills.

5 Discussion and Further Work

Ontology development as learning method is mentioned in [8] with a conclusion that “a good suite of tools, integrating both learning environments and ontology development tools, are required in such a learning process”. The rationale for using formal languages to represent conceptual models developed by learners is that formal languages will enable many kinds of applications that are based on automatic or semi-automatic processing of the formal models. It makes sense to re-use and build on existing tools developed for ontology engineering. Present ontology-based learning applications do not embrace learning processes where learners collectively advance their individual and shared understanding through social interaction. Ontologies may have a significant role in learning when studied from an activity theoretical perspective, in which an ontology can be seen as an artefact that is capable to mediate human activity. Further work may develop methods and techniques to foster knowledge creation e.g. when ontologies can not be mapped and merged automatically, for reflecting the underlying theoretical foundation of ontologies within activity systems. Learning oriented tools include technologies to support the collaborative ontology development embedded within a purposeful activity, evaluation and evolution of ontologies.

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Socially-Aware Informal Learning Support: Potentials and Challenges of the Social Dimension

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Abstract. With increasingly conceiving learning as a social activity, technological support must become more aware of the social context of the individual in order to be able to provide adequate support. But many issues related to making systems socially aware are subject to ongoing research, e.g., the description and mining social relationships, and especially privacy preservation. This paper wants to give a brief overview which possibilities social awareness can offer, and to present a research agenda for realizing these potentials.

1 Introduction

E-Learning is currently undergoing a paradigm shift, from formal, organized, and certifiable towards informal, spontaneously networked, and intangible—and many label it with the striking "2.0" tag. Learning Management Systems, courses, reusable learning objects—everything having to do with formality and content was yesterday. If content was king, then now "context is king" (as Peter Baumgartner put it in [1]): decontextualized and standardized courses are being replaced by in-context learning on demand, especially in workplace learning [2].

However, this shift towards context does not imply that systems are becoming more context-*aware* so that they can respond to contextual needs; rather they provide content *in context* and the possibility of "networking" in a "Social Web". This Social Web offers networking of people (as successful networking platforms like openBC[1] show), of information artifacts (as novel learning theories like connectivism [3] stress) and of tools and services ("mashups" in which technologies like RSS play a prominent role). For this Social Web, which is basically a global loosely coupled platform for continuous learning, fostering the interactions of people in manifold forms is the ultimate goal.

But does this social software understand a person's social context and how it affects the "learning by networking"? It is commonsense that it draws a distinction from whom you learn, whom you help and from whom you receive a message because it affects your willingness, your receptiveness, whether you overcome barriers etc. Leaving all this up to the user may help to build lightweight applications and may be in line with the Web 2.0 idea of man as a self-determined master of a

[1] https://www.openbc.com/

globalized web, but it definitely neglects the affective dimension of information seeking [4] and inter-human communication [5] and their implications on system usability and denies the importance of guidance.

In this paper, we want to introduce the concept of socially-aware applications—understood as applications knowing about the user's social context and adapting to it. In section 2, we present potentials of this concept in the form of three sample applications. In section 3, we discuss the challenges we have to face when realizing these applications before we conclude the paper in section 4.

2 Potentials of Socially-Aware Learning Support

Social relationships do have a huge impact on human behavior, and they do so especially for learning activities. But does this mean that systems should adapt to the social relationships of its user? In this section we want to have a closer look where socially-aware system behavior is strongly needed or at least a promising perspective.

2.1 Social People Finder

Although much attention has been given to formal and semi-formal learning situations the majority of learning activities are informal, especially in workplace learning. One typical learning situation is that one employee asks another (who shall become the "informal teacher") about a problem at hand. In order to support this form of learning, knowledge management solutions usually have an "expert finder" component that tries to locate experts for specific subjects (e.g. [6]).

But do employees always want to ask experts? And doesn't it matter if we know this expert and get along well with her? We have to acknowledge that asking for help always requires admitting a weakness, exposing vulnerability. If there are tensions in the relationship, we will do anything but appear vulnerable. This means that expert finder applications have to balance the "expert status" with the quality of the social relationship towards the potential "expert" in order to provide *relevant* results. As a consequence, a colleague and good friend next door, who is somewhat competent in the area, could be a much better result than the ultimate expert, who is viewed as a rival. This type of scenario can be easily generalized to any form of people finding, e.g., looking for cooperation partners for projects where you have to balance the objective relevance with the social dimension to achieve "subjective relevance" [19].

2.2 Socially-aware Mediation of Communication

If we stick to the expert finder example from the last section, then we will discover an ongoing problem of these "expert finders": usually the expert's side (who is actually an informal teacher) is not appropriately considered. Listed experts get overloaded and distracted from their own work, which leads to annoyance. Often it is not only objective overload and bad timing, but also missing consideration of how the designated informal teacher views her relationship to the learner. For instance, there are always colleagues to whom you will answer even though you are in a hurry, while there are others you will never allow for disturbing you.

In [5] a method was presented that mediates the communication between an informal teacher and an informal learner, taking into account the context of both sides. Each communicative action is assigned a degree of efficiency based on multiple criteria (like current task and its characteristics, urgency, but also the quality of the social relationship). That way, we can reduce annoying forms of communication.

2.3 Socially-aware Opinion Sharing and Resource Ranking

As the success of social bookmarking systems shows, users are willing to rely on explicit opinions of other users, as these opinions represent a form of guidance. Especially when you are new in a certain subject area, it is extremely helpful to get links to "good" resources instead of just receiving resources matching your query. But how do you know if you want to have yourself guided by another user's opinion or assessment? And beyond: how do you know if you want to guide others, especially if they are potential competitors?

An analysis of scientific work within the project *Im Wissensnetz*[2] ("in the knowledge web") has shown that social bookmarking services like Bibsonomy[3] would be used if there was better control with whom to share your findings, e.g., they do not want to share the result of their literature study with competing institute as such, but possibly with individuals within those institutes to whom they have a relationship of trust (cf. [7] and [8] examining the social and cultural impact on knowledge sharing). This means that if systems offered a socially-aware sharing policy, this would overcome classical knowledge management barriers.

3 Challenges of Socially-Aware Learning Support

The previous section has shown that socially aware system behavior can improve the relevance of results, reduce annoying forms of social interaction, and foster collaborative behavior by overcoming trust-related barriers. But realizing such systems poses severe challenges, which shall be briefly summarized in this section.

3.1 Describing the Social Context

Before we can start exploiting the social context, we need a model with focus on qualifying relationships in an appropriate way. Representing only formal relationships like family relationships or organizational relationships is insufficient. Rather we have

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[2] http://www.im-wissensnetz.de
[3] http://www.bibsonomy.org

to consider informal relationships, which can be distinguished along multiple criteria; among the most popular are trust [9], loyalty, expectancy of reciprocity, reliability etc (see, e.g., [10]).

An important insight for developing this ontology is that we primarily do not need to model objective relationships, but rather subjective opinions about the quality of the relationships, because usually our behavior only depends on how we regard the relationships (and not how it "is").

Approaches towards a social relationship ontology are rather scarce. Research in sociology does not concentrate on well-defined, universal definition of relationships. There are some first steps with FOAF[4] in the Semantic Web community like [11] and [12], but their level of differentiation is still too low because of their focus on objective (and often symmetric) relationships.

3.2 Acquiring the Social Context

Having a model for social relationships is quite useless if we do not have methods to fill it. Social network analysis (SNA) is currently quite popular for a wide range of application scenarios. Usually its results are visualized as graphs with weighted edges where the weight represents communication intensity, frequency or importance (e.g. [13]). The work of [18] examines searching algorithms for expertise location by the use of such social network graphs. In [15] and [16] social network analysis is used for improving information retrieval.

Because of their focus on objective relationships ("whole-networks"), the importance of these approaches to our problem is only limited. Especially, they the quality of the relationships is neglected. There, relying on so-called egocentric networks is more promising (e.g., [17]) because they are capable of representing subjective relationships.

3.3 Methodological Framework for Socially-Aware Learning Support

In section 2, we have presented commonsense arguments on how social relationships affect what is to be considered good, relevant, and appropriate. But the world is hardly ever mono-causal. So we need to find out (a) how each type of social relationship and (b) to which degree the social dimension (together with other criteria) affects subjective relevance. Empirical studies will be needed to establish a sound theoretical basis, combined with results from pedagogical research on the role of the social dimension in learning activities. First steps based on a trust-based concepts have been done e.g. in [14].

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[4] **F**riend **o**f **a** **F**riend: http://www.foaf-project.org/

3.4 Preserving Privacy

Privacy is always an issue when dealing with personal data, but qualified social relationships belong to the most critical data items. Even in the "objective" case of social network analysis visualizing existing social relationships within a group of people can have unexpected side-effects by making explicit who is the hub, who is the outsider etc. This is even truer for subjective assessments of social relationships because these subjective relationships are sometimes not symmetric, and it would be disillusioning if this asymmetry was actually revealed.

The problem with socially-aware systems is not only that they have to store this critical data—here we can think of technical solutions for data protection—but their adaptation behavior can sometimes disclose the underlying social relationships.

Let's take the case of the mediated communication where we have to take into account both perspectives on the social relationship between them: What if you never receive a certain person as a recommended communication partner although you assume a good relationship to that person and you discover that she knows about what you need? Another example is if we consider contacts of contacts for people finders: even if the system does not present explicitly how your contact assesses her contacts, the way the results are presented can reveal it to you. Therefore, the system behavior has to be carefully checked so that these sensitive data are not exposed or could not only be traced back to one's subjective view on the relationship.

4 Conclusions and Outlook

Within the movement towards context-aware systems—particularly in the domain of learning support—social awareness appears to be the next frontier of user-adaptive learning support. It is especially promising for addressing informal learning scenarios, as the presented scenarios and preliminary research results in these areas have shown. But even more than other aspects of the user context, the social context has several hard challenges associated with it, which can be traced back to the subjectiveness and the damage of exposition to existing relationships.

The Web 2.0 (and with it eLearning 2.0) has discovered the social dimension, and with the focus on social processes, the distinction knowledge management and (informal) e-learning becomes less and less important. But this is only the first part of the story. Before real-world applications, which currently confine themselves to a very shallow consideration of the social context at best, can be made *socially aware*, a lot of interdisciplinary research questions must be answered. But in the end, applications and services can become a little bit more adaptive to human peculiarities.

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The User as Prisoner: How the Dilemma Might Dissolve

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Abstract. Content objects are essential links between Knowledge Management and E-Learning systems. Therefore content authoring and sharing is an important, interdisciplinary topic in the resp. fields. In this paper, we want to critically elaborate on the "user as producer and consumer"-concept for content production and consumption. We address the subject by using the notion of content collaboration as example for the *"Prisoner's Dilemma"*, in which the sensible way out (from a macroperspective) is sensibly not pursued by an individual (from a microperspective). We will use this micro-perspective of a user as prisoner to analyze what the recently very successful Social Tagging processes can teach us about the user taking action as a producer and/or consumer.

1 Introduction

Knowledge Management (KM) systems as well as E-Learning systems are built on knowledge[1] blocks that contain reified knowledge, i.e. content or learning objects. As objects these knowledge chunks can e.g. be managed, shared, reused, or aggregated; as reified knowledge they can be used pedagogically as e.g. Reinmann declares them to be "the link between learning and teaching" [Rei05, 117]. In particular, software can construct or help to construct learning contexts based on them: knowledge contexts (like ontologies or intersubjective knowledge), didactical contexts (like learning paths), or subjective contexts (like personal learning environments), for examples and ideas we suggest [Koh06], [LG06], or [MHBR05, 53].

Unfortunately, KM as well as E-Learning weren't as successful as expected (with occasional exceptions). Therefore a joint venture was undertaken to harvest synergy effects. The pedagocial approach of constructivism seems to fit well for such a venture because of its highly individualized construction potential (see e.g. [Sch05]). But constructivism posits that the construction has to be done by the user herself. This

[1] In [Kor05] Kornwachs critically discusses the use of the terms 'knowledge' versus 'information' and points to their "fundamental difference"[34], in particular, he points to the "self-referential characteristics"[36] of knowledge that makes its handling via technological systems problematic. Keeping this (as well as [PRR97, 16] and [BD00, 125]) in mind, we use the term "knowledge" nevertheless.

can e.g. be accomplished by self-steered learning (which is tentatively antagonistic in E-Learning environments) or by enabling a learner's adaption/accommodation processes to rebuild existing cognitive structure (Piaget) by envisioning the user as a producer of content. Fittingly, in recent years the needle's eye for KM systems turned exactly out to be the generation of content. So the "user as consumer and producer"-scheme moved in.

In Section 2 we will argue that we can comprise this scheme to a "user as a prisoner"-concept (cf. the well-known "Prisoner's Dilemma"). The dilemma consists in two competing perspectives on taking action: the micro- and the macroperspective, where the first one is disabling content collaboration. In [KK04] Kohlhase and the author discussed this phenomenon as "Authoring Problem", in an educational context in [Koh05] as "User Riddle": even though the advantages of using KM systems for content collaboration seemed tremendous, no action was taken by users to invest the additional energy and effort to produce such content. So, the real problem in the "user as consumer and producer"- concept is the micro-perspective of motivation for action and it is not clear, whether the one or/and the other is more helpful for this.

In order to get a clue though we finally turn in Section 3 to a microperspective analysis of the recently very successful Social Tagging systems like del.icio.us, flickr, or Connotea, in which the "user as prisoner"-dilemma seems to dissolve. We will conclude with the thesis that a joint venture is best done if the user starts her activities as a producer with specific expectations (like added-value services or Personal Knowledge Management) and then decides for herself when the time for consumption (like collaboration or E-Learning features) has arrived.

2 Content Generation as Prisoner's Dilemma

Conventional wisdom (aka. "hope") is that the added-value applications based on semantic annotations will create a stimulus that will entice common users to invest time and effort into content production within this exciting new technology. Unfortunately, respective communities experienced otherwise, e.g. the Semantic Web did not take off as expected even though it is still pursued because of its "believed" potential.

Starting from a detailed look at the motivations of users to produce semantic data, we argued in [KK04] that the discrepancy between a content author's excitement about the fascinating potential of semantically enriched data and her unwillingness to invest her time and energy to profit hereby is actually an author's dilemma — an example of the well-known non-zero-sum game "Prisoner's Dilemma" ([Axe84]). It is often used for analyzing short term decision-making processes in cooperation scenarios, where the actors do not have any specific expectations about future interactions or collaborations. Concretely two players are imagined in a prison scenario where they are independently confronted with cooperation offers by a public prosecutor. They can choose between two moves, either "cooperate" or "defect". The idea is that each player gains when both cooperate, but if only one of them cooperates, the other one, who defects, will gain more. If both defect both lose, but not as much as the 'cheated' cooperator whose cooperation is not returned.

For a user of semantic material, the motivation for preferring semantically rich data is simple: explicit document structure supports enhanced navigation and search, semantic markup yields context and search by content. Furthermore, the higher the degree of semantic structure, the more added-value services can feed on the material, the higher the benefit for the user. But this is only a standpoint from without, that is a macro-perspective. From within, that is a micro-perspective, there is also the motivation against taking action, as (generally) the cost of creating a document is proportional to the depth of the markup involved. However, the argument goes that — once the markup quality passes a certain threshold which supports flexible reuse of fragments — content creation costs may actually go down as they are dominated by the cost of finding suitable (already existent) knowledge elements. Thus, the author is interested in a high reuse ratio, provided that retrieval costs are not prohibitive. The benefits seem obvious for the author who has the opportunity to reuse her own content modules frequently, but the real payoff comes when she is part of a group of individuals that share content objects and knowledge structures freely.

The analogy of the "Prisoner's Dilemma" to the content author's situation is apparent: if the author decides to invest her time and effort and others contribute as well, everyone profits tremendously from this synergy of cooperation. On the other hand, if just the author works on semantic markup, then she will gain nothing in the short run, but some in the long run. Note that the microperspective is less than a subjective standpoint, it considers only the surrounding micro-cosmos, the here-and-now of a subject.

In the Prisoner's Dilemma, if the decision-makers were purely rational, they would never cooperate (without at-hand incentives) as they should make the decision which is best for them individually. Suppose the other one would defect, then it is rational to defect yourself: you won't gain much, but if you do not defect you will have all the work. Suppose the other one would cooperate, then you will gain (especially in the long run) whatever you decide, but you will gain more if you do not cooperate (as you don't have to invest your time and effort), so here too the rational choice is to defect. The problem is that if all content authors are rational, all will decide to defect, and none of them will gain anything. In particular, *if we assume content authors to be rational, then we anticipate their non-cooperation based on the individuals' micro-perspectives.*

3 Why does Social Tagging as Content Generation succeed?

What we are looking for is a way out of the "user as a prisoner"-scheme. We illustrated above that the Prisoner's Dilemma is based on two competing perspectives: the micro- and the macro-perspective.Moreover, the micro-perspective turned out to be the limiting factor for an author's content generation. Therefore, if we continue to predominantly take the macro-perspective when developing software systems, then the "user as producer and consumer"-concept is reduced to the "user as a prisoner"-scheme.

Recently though, web software comprised under the term "Social Tagging" is celebrating enormous growth rates in terms of user access and acceptance rates (despite rather simple interfaces). Here, the users tag system-specific objects like bookmarks (e.g. del.icio.us or scientifically Connotea) or images (e.g. flickr) to organize and share their resp. objects so that they become *"pivots for social navigation"* [Mor05, 137]. A closer look reveals directly that their users are not only producers of content, but also managing and learning content consumers. They take action in generating content and using other's content by the emergent "self-organizing" web-effect of *"small pieces that then loosely join themselves"* [Wei02, 82, 23]. The question is why these social tagging systems succeed in attracting considerable amounts of (informal) content authors? If we look at the "Social Tagging" phenomenon from the macro-perspective, then there is not so much to be gained. Sure, there is the possibility that someone else's bookmark might be of relevance to my personal knowledge and I would not have found it except using the social tagging software. But the finding of such a treasure seems rather haphazardly organized and therefore not to be the underlying motivation for using the software.

The idea for dissolving the "user as a prisoner"-scheme consists in a microperspective analysis of this successful software to come up with more general conclusions for the design of software for KM and E-Learning. So we can rephrase the underlying question to be "Why do people use social tagging systems or what is their motivation?". Even though all tags as a whole form a "folksonomy" [Wal04], this collaboration clearly isn't the motivation for an individual user to take action. We believe that a user's tags can be viewed from the microperspective as her personal knowledge management system that e.g. represents a personal information model (PIM, [MHBR05, 53]). At the beginning she doesn't think of her tags as public objects but as private ones. It really doesn't matter whether a user is aware that the tags are openly viewable as the experience of the Web itself constitutes global invisibility and irrelevance. This thesis is supported by many reports of bloggers, who are astonished how much publicity a blog de facto draws (for example: *"it's recently become apparent that the vast majority of blogs are written by ordinary people with much smaller audiences in mind"* [SNGS04, 1143]). However, as a personal knowledge management system the social tagging software support is definitely helpful in tackling today's overly abundant information flow — the same idea that enlivens Berner-Lee's Semantic Web vision [BLF99] from a macro-perspective. But in contrast to the Semantic Web, people are willing to invest their time and energy to assign personal, semantic metadata to resp. objects as it makes sense from their very own personal micro-perspective. The interest for other users' input comes later — whenever the individual user is ready. At that point in time we have a flowing transition from personal knowledge management to social E-Learning. Interestingly, the user decides *for herself* when she wants to change from being a producer to becoming a consumer, i.e. it is a self-steered process. This fits nicely with the observation that an individual's competence development has a time component and therefore has to be viewed as a process (see [BW05]).

In accordance with the "Prisoner's Dilemma", social tagging can teach us that taking action is much easier as producer with specific expectations for consumption — that at first are typically rather private than public — than as consumers with unspecific ones as well as producers with specific ones for production. Actually, the same is true and long known for consumers. Specific consumption expectations of consumers like interface and interaction design are still a hot research topic.

Moreover, the transparency of early personal computers (i.e. specific expectations of consumers for production) was replaced/complemented by Macintosh's iconic style or graphical user interfaces (i.e. specific expectations for consumption) relatively early on (see [Tur97, 23ff]). Now, that the consumers are consuming "well enough", the question of specific expectations of consumers for production comes into focus again.

As many users of social tagging systems have experienced in the mean time, once this dynamic spiral is in place, it enables much finer-grained semantic annotation. In general, once the first steps were taken by the user as a producer, at some point she will become a consumer and will strengthen the mentioned spiral.

4 Conclusion and Outlook

In the same way as knowledge and learning are dynamically interwoven, the according supportive technology can obtain synergies, but we as system designers cannot sensibly start with the macro-perspective and overwhelming, abstract potential, otherwise we support the "user as prisoner"-scheme. Rather we need to use the micro-perspective and provide specific expectations (like value-by-itself e.g. a personal KM system, short-term rewards e.g. occasional hits with recommender systems, and/or added-value services that do not assume collaboration e.g. visualization of complex content) for content authors to draw them into the spiral of "users as producers and consumers". The analysis presented in this paper will form the starting point for the development of a stepwise process of content generation (working title: "Stepwise Blended Learning and Knowing"). We plan to implement and evaluate this in the context of the CPoint system (implemented by the author)[2], leveraging a central aspect of the social tagging process: the transition from Personal KM up to a social, but self-steered E-Learning System.

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Building Lifelong Learning Networks of Teachers for the Development of Competence in Teaching in Small Rural Schools

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Abstract. This paper reports on ongoing research efforts and discussions about how to enable, through new technologies, the building of lifelong learning networks and the development of competences of teachers who work in small rural schools. Teachers of such schools are confronted with significant challenges, needing to develop personal competences falling beyond the established initial and in-service teacher training curricula. The notion of communities of practice (Wenger, 1998) is proposed as a conceptual tool in the endeavour to better understand the issues emerging.

1 Multigrade schools: The 'Borderers' of the Education System

In many primary schools of the Greek provinces there is not one teacher available for each of the six grades: the low number of students statutorily justifies the employment of less than six teachers –even of one or two–, who nevertheless are expected to cover the needs of a full school. These schools, known internationally as multigrade schools [1], fulfil a function of national importance, as they provide the children of remote and less accessible areas with the access to education which all children of Greece are entitled to.

1.1 Teachers in Multigrade Schools: Need for, and Obstacles to, Continuous Professional Training and Competence Development

Teachers of multigrade schools are confronted with significant challenges, as they have to teach simultaneously two or more age groups and possibly more than one curriculum subject in the same class. Teachers' initial professional training does not suffice and the need for competence development is evident – especially in the light of the fact that typically inexperienced, newly-appointed teachers are posted to remote schools for a relatively short term service. Thus the average teacher working in a small rural school needs to acquire new knowledge and skills and continually improve their expertise in teaching in the demanding context of the multigrade classroom. They need to develop personal competences falling beyond the established initial and in-service teacher training curricula, which are oriented towards conventional monograde teaching, in order to develop and maintain the ability to respond to the challenging circumstances of their professional position.

However, there exist a number challenges in connection to remote rural teachers' need for competence development. On one hand, offering teachers from remote areas conventional professional development provision, such as in-service training seminars, is not easy. A teacher's round trips between their remote school and an urban training centre tend to be costly, if not virtually impracticable, given that there may not be a colleague available to replace them during their absence. On the other hand, the very concept of competence in the context of multigrade teaching may not be as straightforward as it appears. In the field of Human Resources Management competence is usually defined as a standardized requirement for an individual to properly perform a specific job, encompassing a combination of knowledge, skills and behaviour utilised to improve performance. However, whether a teacher is adequately or well qualified so as to have the ability to perform successfully in the multigrade classroom is a question with no official, standardised answer. The educational system –in Greece at least–, through its choices for the preparation of teachers-to-be, does not clearly define what good multigrade teaching is. Teachers are more or less left alone to explore and learn multigrade teaching on their own, through their solitary experiences in remote rural schools. What is worse, teachers at remote schools also suffer the consequences of a widening socioeconomic and digital divide which separates the rural from the urban areas in most parts of the world.

2 Greece: A Case Reflecting International Trends

The above described difficulties of multigrade teachers working in remote areas are not unique to Greece. Internationally, the shortage of teachers in rural and remote areas, and the weaknesses of the education systems in the provision of training and professional support to these teachers, have been well-documented in the literature [2], [3], [4], [5], [6], [7], [8]. However, these problems appear to be in sharp contrast with a growing recognition of multigrade schools as not only a necessary, but indeed a good-quality option for education systems, believed even to have some advantages over single-level classes [9], [10], [11].

2.1 The Use of ICTs

As a response to the obstacles described earlier, the use of different forms of technology-supported learning and distance education models have been advocated for the enhancement of quality and accessibility of teacher training programs in rural areas [12], [13]. Relevant attempts have followed the technological trends in the field of computer-supported learning, while the content of training delivered via the different technologies varies greatly, from conventional seminar-type lessons to classroom observations at a distance [14], [15], [16], [17], [2]. What is more, in recent years a lot of attention is paid to the role satellite telecommunications can play for the bridging of the digital divide [18], [19], and distance education is seen as a major field of application in this area, as this technology provides a delivery option facilitating access to new student populations in distance locations [20]. Significant experience has already been gained internationally, particularly in the United States and in Australia (e.g. [21], [22], as well as in other less developed countries with populations distributed over large geographical areas (e.g. [23], [24], [25].

3 Our Response to the Challenges so Far

This growing mass of international experience clearly demonstrates that emerging technologies offer promising solutions to the challenges of providing appropriate training and support to rural educators. Adopting this as a proposition in our work in the framework of a number of pioneering European and national research projects, our team has in recent years made efforts to alleviate the isolation of teachers working in remote schools through the provision of distance training, support and networking, using to the full the possibilities offered by new technologies.

The main questions we have addressed in the course of almost six years of consecutive projects, have referred to: a) the appropriate content of the relevant professional development and support activities; b) the appropriateness of the various available and emerging delivery technologies, given the remote and digitally disadvantageous location of the beneficiaries; and c) the possible extensions to conventional e-learning technologies and practices, which could help the geographically disadvantaged rural educators to learn as individuals and to learn from each other, participating in informal learning experiences within a sustainable lifelong learning network.

The whole effort started with a rather greater emphasis on teachers' competence development through training content delivered over the web (MUSE project); it gradually moved into testing more advanced technologies for broadband delivery over satellite, while continuing to further develop the content (ZEUS and RURAL WINGS projects). The 'maturity' brought about through the training experiences and the increasing involvement of remote rural teachers led to the development of a network (NEMED) and an increased interest in concepts and tools related to lifelong learning networks (NEMED, RURAL WINGS) (Fig. 1). The projects, their interconnections and outcomes are presented below in more detail.

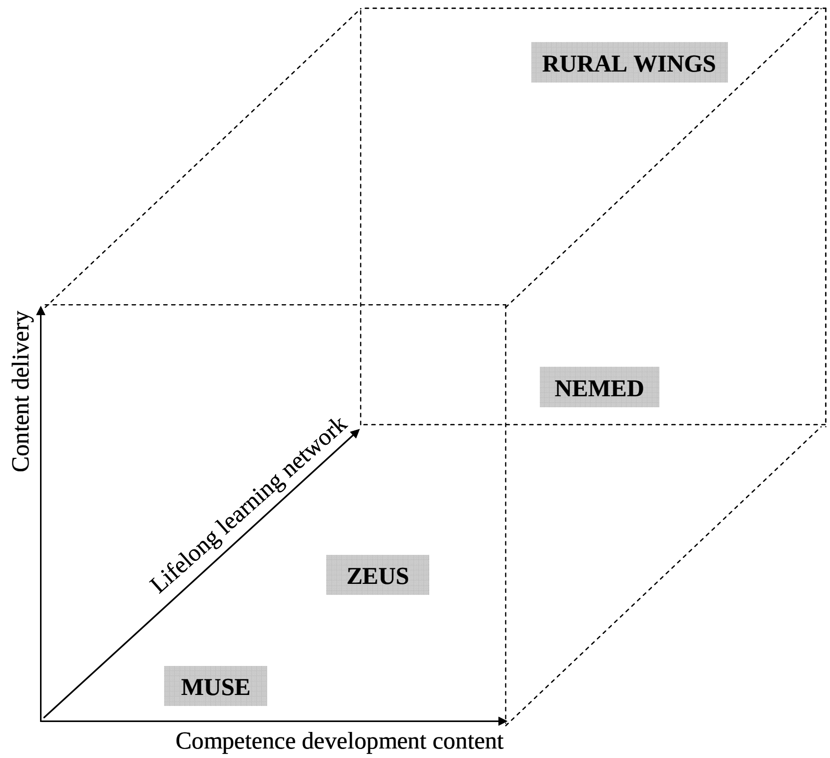

Fig. 1. Positioning of *(projects)* along three ***(axes of inquiry)***

A first milestone in our effort was the European project MUSE (MUltigrade School Education), which was supported by the Socrates Programme – Comenius 2.1 Action (2002-2004). In this project, through close international collaboration between teachers and researchers, an innovative, specialised in-service training programme was developed for teachers working in multigrade schools. The main outcome of that project was a realisation of the need of multigrade teachers in Europe for training in innovative teaching and learning approaches that are well-suited to the multigrade school environment, including the use of ICT in everyday school work, as well as the development of a relevant training programme promoting teachers' professional development in these fields. Thanks to the MUSE project, training material specifically designed for multigrade school teachers was for the first time made available to all who may be interested, via the internet.

A follow-up of the activity developed within MUSE has been the networking, at the European level, of educationists and school practitioners sharing an interest in multigrade schools, either as a field of research or as a space of educational practice that deserves attention and support. This contact and exchange is taking place within the European network NEMED (NEtwork of Multigrade Education), a trans-national network supported by the Comenius 3 Action of the Socrates Programme (2004-

2007). Through its activities in ten European countries and at pan-European level, the network is currently studying the characteristics and the needs of multigrade schools, is actively promoting the upgrading of questions relating to multigrade education in educational policy-making, is investigating and proposing ways to improve the education provided by multigrade schools, as well as offering support to multigrade school teachers and fostering the development of communication among them. What is more, there is a specific interest of the Network in developing the NEMED web portal, which should foster and enhance the functioning of NEMED as a lifelong learning network for Europe's multigrade teachers. In addition, NEMED regularly organises international workshops and conferences, aiming at the widest possible dissemination of knowledge and experiences accumulating within the network, as well as the sensitization of the world of education towards multigrade schools and their issues.

At the same time, a lot of the energy and attention of our team has been devoted to securing better channels for the delivery of rich training and support content, as well as for enhanced communication among isolated teachers, so as to drastically combat the introversion of the digitally deprived remote school. In this context the ZEUS project (2003-2005) timely recognized the crucial role of satellite telecommunications for securing broadband for geographically disadvantaged populations. This project offered to remote teachers a rich distance learning environment for participating in synchronous and asynchronous training via satellite networks. This was an initiative at the national level, supported by the General Secretariat for Research and Technology within the Concerted Programme for Electronic Learning. The training programme was attended by teachers at ten sites in the extremities of Greece, via satellite installations made by the project at their schools. The research in ZEUS focused mainly on the appropriateness of the training content (which built on the MUSE content, extending and enriching it), the development of a distance training organisation and delivery method (which is described further below), and the testing of connectivity through DVB one-way satellite links as a channel for distance training delivery to remote teachers. The outcomes of this project in terms of training content and methodology are described in detail further below. As far as the technology is concerned, the DVB satellite link, demanding the use of non-broadband terrestrial infrastructures (broadband downloading from the satellite, uploading through ISDN telephone line), caused some technical problems and relevant user dissatisfaction, which clearly indicated the way forward.

A 'child', in many respects, of the ZEUS project, and the peak of the whole effort is RURAL WINGS (2006-2009), an ambitious, large-scale international research project supported by the Directorate-General for Research of the European Commission (Thematic Priority 'Aeronautics and Space' of the 6th Framework Programme). This project takes several decisive steps ahead, not only in the field of technology, but importantly also by carefully addressing the real needs for learning of all citizens living in remote rural areas, and by fostering the development of lively learning communities in remote schools and the villages hosting them. On one hand, DVB-RCS technology is used, which allows for two-way communication between the end-user and the satellite lifting the need for any terrestrial telecom infrastructure, thus rendering broadband really available everywhere, even in the most isolated and deprived area. At the same time, the RURAL WINGS project integrates satellite telecommunications with local wireless networks, thus demonstrating the appropriateness of satellite technologies for the provision of fully integrated services and applications to the whole of the remote rural population. What is more, RURAL WINGS builds on the successful approach of the ZEUS project to develop an advanced technological environment supporting lifelong learning activities in the school, at work, as well as at home. In this way, familiarization of all citizens with the new technologies is promoted, resulting in a reduced resistance to the use of state-of-the-art opportunities for local development. Teachers working in remote rural schools –the main target group in the pilot applications in Greece– undertake a crucial role in this process. Through further support, professional development and networking, teachers of rural areas are encouraged to evolve into catalysts of change and development, not only within their schools, but more widely within their local communities.

4 The Training Programmes and the E-learning Technologies

Based on initial analyses of teacher needs, professional development schemes piloted in the above projects aim at helping multigrade school teachers to develop their professional skills along two main axes:

- Use of ICT in their work, both for teaching/learning and administrative purposes.
- Application of teaching and learning approaches which are most appropriate for the multigrade classroom.

The corresponding e-learning environments have been realised through several technologies, exploiting satellite telecommunications for broadband delivery of rich educational content, in the context of both synchronous (videoconferencing, application sharing, chatting) and asynchronous (web-based learning through structured access to a rich pool of educational content, and networking) activities. Of particular interest in the current context is the NEMED web portal. This is a networking web space serving all network actors by facilitating communication and exchange, sharing of information and conducting of research, as well as provision of professional development and support opportunities to multigrade school teachers. The portal is divided in six identically structured areas, which correspond to the six working groups of the network: ICT for multigrade schools; classroom management in multigrade schools; society, cultures, and the multigrade school; learning modes in the multigrade classroom; educational resources development for the multigrade school; policies for multigrade education.

In a working group area, users can access work relating to research, educational resources, and training materials, as well as participating themselves in ongoing work by uploading their own contributions. Users may also view and download the different Reports of this working group to the whole NEMED Network, while there is also a dedicated area to facilitate communication and exchanges within the group in the form of asynchronous forums. On the whole, the NEMED Networking Portal is meant to be a lively virtual space of structured exchange between network partners, participating teachers and schools, as well as any other users interested in multigrade education.

5 A Model for Training Delivery

It has been a firm belief of the team that, although technical specifications do play a crucial role in a distance-education scenario, the success or not of the effort mainly depends on the underlying pedagogical design [26]. In line with this, the training programmes produced aim to cater for both flexibility and guidance, both interaction with others and self-paced learning. To this end, a comprehensive model for training delivery has been developed and tested in the framework of these projects (mainly ZEUS) (Fig. 2).

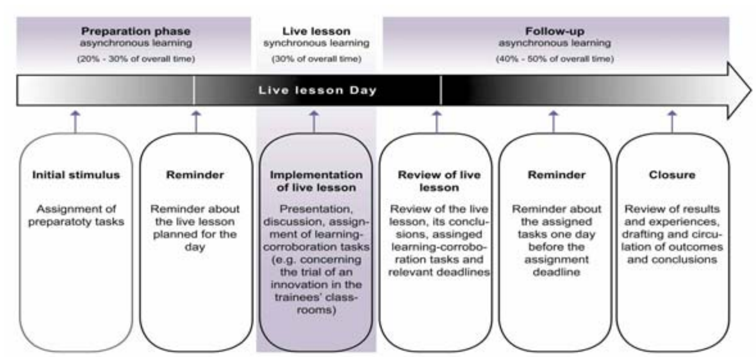

Fig. 2. The *(ZEUS model)* of training delivery

In this model, the central event for each lesson is a live videoconferencing session, using a synchronous e-learning tool, thus covering the need of isolated teachers for communication and real-time interaction with colleagues and instructors [27], stressing the importance of interaction in similar settings). On average, this synchronous e-learning portion of a lesson takes up about 30% of the overall lesson duration.

As can be seen in Fig. 2, however, both before and after the live session there is learning activity taking place independently in the working environment of the trainee. Through the use of web-based instruction techniques course participants are offered on-the-job training opportunities through tasks and materials that allow them to work at their own pace, interact with the instructor and other practitioners as needed, and receive individual feedback as they applied information to their classroom settings. For each lesson, there is introductory information on the topic covered, preparatory activities, the outcome of which are then reported by participants in the web environment and during the live session, as well as post-session consolidation and conclusion activities. The training delivery model has generally been well received by trainers and trainees.

6 Outstanding Questions: Emerging Issues of Lifelong Learning Networks and Competence Development

In all the work described above, two central concepts of this workshop, Life Long Learning Networks and Competence Development, form two major, albeit not always explicitly acknowledged, conceptual pillars.

The various efforts have led us to provide teachers working in remote small rural schools with opportunities for continuous professional development, through a number of different training initiatives, which foster the improvement of personal competences in rural teachers. In parallel, we have been experimenting with methods aiming to develop and foster a learning network of teachers, which will hopefully provide a framework for the acquisition and sharing of knowledge in an informal communication process (informal learning) lying beyond and supplementing teachers' formal professional education.

Realising the issues and challenges arising, our team has started investigating further the characteristics of tools and methodologies which can foster the improvement of personal competences in rural teachers (competence development), and encourage and facilitate a teacher's contributions to the development of the other teachers (lifelong learning network). In this context, we are currently revisiting the training delivery model mentioned above (Fig. 2) at the micro level, aiming to identify, adopt and/or adapt methods and tools which could be incorporated in this general model in order to facilitate and support informal learning through peer interaction. In other words, we are currently investigating ways of effectively combining competence development and lifelong learning networking priorities and initiatives.

At the level of technology, too, our team has come to realise the limitations of the conventional e-learning technologies and models, when the issue at stake turns into how to promote and facilitate competence development through networking with peers – a lifelong learning experience of multi-site and episodic nature. What is crucial at this stage is to identify the features and clarify the main issues connected with the technology/-ies which will be able to support rural teachers, both as individuals and as members of teams within the educational system (an 'organisation' in itself), to further develop their competences making use of the distributed knowledge and learning resources available. The NEMED portal is our current attempt in this direction, which has so far managed to develop into a repository of teaching and learning resources connected to multigrade education, jointly created and update by the teacher-members. It clearly needs to be further developed in the light of contemporary advances in social software and in fields such as knowledge organisation, collaborative authoring and learning, discovery and exchange of knowledge resources, personal profiling and ePortfolios, competence assessment and monitoring of change, etc. What is more, the newly-started RURAL WINGS project provides ample opportunity and challenge to organise the numerous learning resources and diverse learners in rural communities worldwide into meaningful, working networks fostering lifelong learning and competence development, within its own learning-enabling portal.

In the endeavour to better understand and enable our vision of lifelong learning networks of rural teachers, we have found the notion of communities of practice [28] to provide a powerful conceptual platform. According to Wenger, communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly. We are then aiming in this case to enable the development of a community of practice of rural teachers, which is defined by a shared domain of interest, that of the development of multigrade teaching competences. We need to establish members' commitment to the domain, and facilitate community development by assisting them to engage in joint activities and discussions, help each other, share information and learn from each other, while pursuing their interest in their domain. This will be indeed a community of practice rather than a mere community of interest, as members of the community will be rural teaching practitioners developing a shared repertoire of resources – a shared practice: experiences, stories, tools, ways of addressing recurring problems in their small rural school, etc.

This kind of learning of course takes time and requires sustained interaction – which are some more of the things that the technologies we are envisaging have to afford. Likewise, the technologies will need to support and facilitate a variety of activities through which communities develop their practice, such as problem solving, requests for information, experience seeking, reusing of assets, coordination and synergy, discussion of developments, mapping of knowledge and identification of gaps, etc [28]. How this can be designed and realised given current technological developments remains for us an open challenge.

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Competence and Performance in Requirements Engineering: Bringing Learning to the Workplace

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Abstract. Challenges for learning in knowledge work are being discussed. These include the challenge to better support self-directed learning while addressing the organizational goals and constraints at the same time, and providing guidance for learning. The use of competencies is introduced as a way to deal with these challenges. Specifically, the competence performance approach offers ways to better leverage organizational context and to support informal learning interventions. A case study illustrates the application of the competence performance approach for the learning domain of requirements engineering. We close with conclusions and an outlook on future work.

Learning in Knowledge Work: The APOSDLE Approach

With the term knowledge worker we refer to an employee of an organisation whose essential operational and value creating tasks consists in the production and distribution of knowledge (Machlup, 1962). Knowledge Workers are predominantly controlled by overall goals and expected results instead of defined procedures. Thus, they have significant autonomy in structuring their activities (such as timing and procedures) (Pyöriä, 2003; Davenport, 2005).

Learning in knowledge work operates in a constant tension between personal goals and organizational constraints. On the one hand, knowledge workers increasingly learn in an informal and self-directed manner (Pinchot & Pinchot, 1996). On the other hand, aligning learning to organizational goals and task requirements is an important factor. This even poses challenges for traditional personnel development instruments and trainings. How this alignment can be addressed within knowledge work, remains an open issue even more (Elkjaer, 2000).

This is also reflected in the differences between eLearning and Knowledge Management (KM) approaches. While eLearning has traditionally focused on providing guidance to learners by structuring content according to pedagogical models, KM has focused more on self-directed aspects of information search and knowledge sharing with a lack of addressing learning issues (Ras, Memmel, &

Weibelzahl, 2005). While in traditional eLearning the guidance may be too strict to address challenges of knowledge intensive work, KM certainly has neglected that certain structures are needed for learning to take place.

As a result of this discussion, two challenges can be identified when addressing learning in knowledge work: (1) the tension between individual goals and organizational goals and constraints, and (2) the "problem of the amount of guidance" (Ras, Memmel, & Weibelzahl, 2005, p. 158). These challenges are currently being addressed in the APOSDLE project[7]. The goal of APOSDLE is to create a process-oriented learning environment which supports knowledge workers to work and learn at the workplace. The APOSDLE approach to workplace learning addresses the challenges by offering knowledge workers easy access to relevant knowledge artefacts and persons, and thereby giving them considerable freedom to work and learn in a self-directed manner. In order to address organizational issues as well, APOSDLE looks at the organizational context in which the knowledge worker operates (Ulbrich, Scheir, Görtz & Lindstaedt, 2006).

One of the elements of this context is made up of the competencies needed for performing the work the knowledge worker is engaged in. Specifically, our goal is to suggest ways in which a competency gap (i.e. a gap between the competencies required for a task, and competencies the knowledge worker has available) can be (semi-)automatically inferred from a comparison of a person's task performance in the past, and the tasks she is about to tackle in the future.

The purpose of this paper is to suggest a framework which formalizes the connection between knowledge intensive tasks, such as ones performed in a requirements engineering activity, and the competencies needed to perform these tasks. The framework informs an implementation methodology. This is then introduced and illustrated by means of a case study conducted in the domain of requirements engineering.

A Competence Performance Approach for Workplace Learning

The use of competencies has often been advocated as a way to deal with the challenges in workplace learning (Green, 1999; Lucia & Lepsinger, 1999; Erpenbeck & Rosenstiel, 2003). Specifically, competencies are being used to more closely relate learning to organizational requirements (such as goals or task requirements). Ley, Lindstaedt and Albert (2005) have suggested the competence performance approach as a model to formalize competencies and their connection to workplace performance for work-integrated learning.

With the competence performance approach Korossy (1997, 1999) has introduced an extension of knowledge space theory (Falmagne et al., 1990; Doignon & Falmagne, 1999). Knowledge space theory has been developed in the 1980s and 90s as an attempt to model a person's knowledge state as close as possible to observable behavior. It is predominantly concerned with the diagnosis of knowledge and has

[7] APOSDLE is an Integrated Project (IP) partially funded under FP6 of the European Community. For more details, see http://www.aposdle.org.

been applied in adaptive testing and tutoring scenarios and system (e.g. ALEKS Corp., 2003; Hockemeyer, Held & Albert, 1998). The fundamental idea of knowledge space theory is that a person's knowledge state in a certain domain can be understood as the set of problems this person is able to solve. Since solution dependencies exist among the problems, it is possible to present a person only a subset of all problems of a domain in order to diagnose his/her knowledge state. The collection of all possible knowledge states is called a *knowledge space*. A knowledge space is a partial order and is stable under union.

In an attempt to develop Knowledge Space Theory further, Korossy (1997) suggests that in addition to the set of problems, one should look at the set of competencies, that is knowledge, skills and abilities needed to solve the problems. This would generate information on the *reasons* for different levels of performance, and thereby help to suggest learning measures. Similar to the set of problems, competencies are also structured in a competence space which results from a surmise relation on the set of competencies.

The relationship between the two sets (problems and competencies) is formalized by an *interpretation function* which maps each problem to a subset of competence states which are elements of the competence space. This subset of competence states contains all those competence states in each of which the problem is solvable. The interpretation function induces a *representation function* which assigns to each of the competence states all problems which are solvable in that competence state. Which problems are solvable is determined by the interpretation function.

The competence performance approach has been applied in technology enhanced learning applications. For example, Hockemeyer et al. (2003) have assigned "competencies required" and "competencies taught" as metadata to a collection of learning objects. Thereby, prerequisite structures are derived for the eLearning content which allow for adaptive tutoring. New course content could easily be integrated, as metadata was only held locally.

In the current approach, we define *competencies* as personal characteristics of job holders which they bring to bear in different situations. Competencies are hypothetical constructs which determine performance in a job. The term *performance* is understood to encompass all behaviors relevant for the accomplishment of a certain task in a specific situation (Schmitt & Chan, 1998). We will differentiate competencies into more stable characteristics such as personality traits (or temperaments), motives and cognitive abilities, and more variable characteristics, such as skills and knowledge. This differentiation is in line with a large body of research into KSAOs (knowledge, skills, abilities and other characteristics) (Lucia & Lepsinger, 1999; Schmitt & Chan, 1998).

Case Study: Modeling Competencies for Requirements Engineering

This section introduces the methodology we use to model competencies within the competence performance framework. The methodology has already been applied in different settings (i.e. in the automotive industry and in a research based setting) (Ley, Albert & Lindstaedt, in press). We have recently conducted a further case study focused more directly on supporting workplace learning. We briefly introduce this case study here. It will then be used to illustrate the procedure employed for deriving competence performance structures.

The case study is currently being conducted as part of the APOSDLE project where the learning domain for a first prototype is requirements engineering (RE). The learning environment targets persons with various levels of expertise in RE who are working in a requirements engineering project. They may be domain experts with little knowledge of RE who have been made responsible for eliciting requirements for a system to be built, or RE specialists who need only little guidance to conduct RE projects. Specifically, we are using the RESCUE process (Requirements Engineering with Scenarios in User-Centered Environments, see Maiden et al. 2004).

RESCUE is an innovative process developed for the elicitation and specification of requirements for socio-technical systems. RESCUE supports a concurrent engineering process in which different modeling and analysis processes take place in parallel: Human Activity Modeling is done to provide an understanding of how people work in order to baseline possible changes to it. The aim of System Goal Modeling is to model the future system boundaries and dependencies between actors for goals to be achieved. The Goal Modeling is formalized with the i* notation. Use Case Modeling is the process of writing use cases for the future system, exploring it with stakeholders and carrying out impact analyses in order to obtain consistent and valid requirements. These sub processes are aligned at designated synchronization points. During the whole elicitation process, RESCUE provides guidance on requirements management. Furthermore the use of creativity workshops encourages requirements and design ideas to be discovered and elaborated together.

In the following sections, the methodology for modeling competence performance structures will be introduced. According to Ley & Albert (2003a), the methodology entails the following three steps: (1) derive a set of tasks (performance) for the position in question, and for the learning domain to be supported (see 3.1), determine competencies needed to successfully perform the tasks (see 3.2), and relate tasks and competencies in a task competency matrix (see 3.3). These three steps focus on the process "defining competencies" mentioned in the overall organizational competency management process presented by Ley, Albert & Lindstaedt (in press). Section 3.4 then suggest a way to use and validate the resulting structures.

Deriving a Set of Tasks

The tasks can be derived from a detailed analysis of the work to be performed in the chosen domain. It is important that tasks do well reflect the learning domain in question, and that performance in these tasks can be assessed with regard to some quality criteria which are agreed within the organization (i.e. whether a task has been performed well or poorly).

We have previously employed hierarchical task analysis to find tasks employees perform in a certain position (Ley & Albert, 2003b). In Ley & Albert (2003a), we have chosen documents produced by the workforce as a way to reflect the more dynamic nature of the tasks.

In the present case study, the set of tasks is rather easily obtained as there exists extensive documentation for the work to be performed in RESCUE. The set of tasks was derived by means of a detailed content analysis of the RESCUE process document (Maiden & Jones, 2004). We focused on the two streams *Human Activity Modeling (HAM)* and *System Goal Modeling (SGM).* As a result, a first list of tasks was obtained for these two streams and later reviewed by the authors of the RESCUE process. The final list of tasks was composed of 29 tasks in the *HAM* stream, and 18 tasks in the *SGM* stream.

Deriving Competencies Needed

When eliciting competencies needed, we rely to a large extent on techniques for eliciting knowledge from domain experts with structured interviews or questionnaires. For instance, Ley & Albert (2003a) have used the Repertory Grid technique to elicit competencies from documents which the experts had written in the past. In the present case study, a first open ended interview was held with the two RESCUE experts mentioned above. We considered the tasks obtained in the previous step and asked the experts to name competencies (knowledge and skills) needed to perform well in these tasks. The interview data obtained was then complemented with data derived from the analysis of existing documented sources from related research, such as van den Berg (1998) and National O*NET Consortium (2005). From these sources, an extensive list of competencies was obtained, cross-checked for consistency and then validated with the RESCUE experts. In total the list consisted of 33 competencies.

Table 1: Tasks in System Goal Modeling Selected for the Example

	Tasks
1_1	Build a first cut Context Model to identify system boundaries
1_2	Carry out an initial stakeholder analysis
1_3	Develop an extended Context Model
1_4	Allocate functions between actors according to boundaries
1_5	Identify intentional strategic actors
1_6	Model dependencies between strategic actors
1_7	Write different forms of dependency descriptions
1_8	Produce an integrated SR Model using dependencies in the SD model
1_9	Check the i* Model for completeness and correctness
1_10	Validate the i* SR Model against the SD model (cross-check)

To exemplify the procedure, we have selected a subset of tasks to be achieved in the sub-process of *System Goal Modeling*. Table 1 shows the lists of tasks, Table 2 shows the list of competencies selected for our example.

Table 2: Competencies in System Goal Modeling Selected for the Example

	Competencies
A	Knowledge about actors, tasks, goals and resources
B	Knowledge of different types of system stakeholders
C	Knowledge of building the Context Model
D	Knowledge about the Strategic Dependency Model (SD-Model)
E	Knowledge about the Strategic Rationale Model (SR-Model)
F	Ability to produce an i* Model
G	Judgement and decision making skills
H	Knowledge of guidelines for validating the SR Model

Constructing Competence Performance Structures

To build the interpretation function, the experts were asked to assign to each task those competencies they regarded as mandatory for successfully accomplishing the respective task. This was done by means of a *task competency matrix* (see Ley & Albert, 2003a). In the present case, the experts were asked to give their assignments independently from each other. This way, agreement can be measured as one way to evaluate the methodology and the resulting structures (see below). In continuing the example from above, Table 3 gives the results of this assignment. The crosses in the matrix indicate the minimal interpretation for each task, i.e. the set of competencies that a person has to have at the minimum to be able to perform the task well.

To obtain the whole competence space, the competence states of the minimal interpretation were closed under union and the empty set was added. Furthermore, for every competence state the representation function was built by assigning to every state the set of tasks a person would be able to accomplish in the respective state, thereby obtaining the competence performance structure.

The competence performance structure derived for the example above, can be seen in Figure 1. In this example, a person who is in the competence state {B, C, D} should perform well in the tasks {1, 2, 7} (the respective performance state). A person who is able to accomplish task 4 (*Allocate functions between actors according to boundaries*) is assumed to be able to also perform task 2 (*Carry out an initial stakeholder analysis*) because any performance state which contains task 4, also contains task 2. In other words task 2 is assumed to be a prerequisite of task 4, since the minimal interpretation of task 2 ({B}) is a subset of the minimal interpretation of task 4 ({A, B, C}).

Table 3: Task Competency Matrix and Minimal Interpretation of tasks in SGM

		Competences								Minimal Interpretation
		A	B	C	D	E	F	G	H	
Tasks	1_1		X	X						{B, C}
	1_2		X							{B}
	1_3		X	X				X		{B, C, G}
	1_4	X	X	X						{A, B, C}
	1_5	X	X	X				X		{A, B, C, G}
	1_6	X	X	X	X		X	X		{A, B, C, D, F, G}
	1_7				X					{D}
	1_8	X	X	X	X	X	X	X		{A, B, C, D, E, F, G, H}
	1_9	X			X	X	X			{A, D, E, F}
	1_10	X			X	X	X		X	{A, D, E, F, H}

The purpose of this procedure is to limit the number of competence states (and performance states) that can be expected to appear in a population as a consequence of the prerequisite relationships. As a result, several adaptive procedures can be applied that can be utilized when the structures are put to use (see next section).

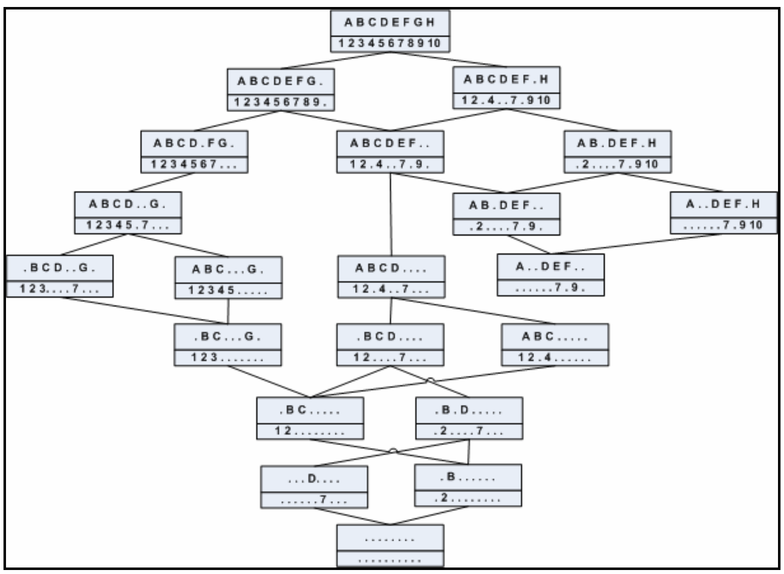

Fig. 1. Competence Space and Representation Function for the Example

Using and Validating the Structures

Given a valid structure of the domain, one can diagnose the competence state of a person by evaluating his/her performance in the tasks being performed, and thereby derive competency gap. Given certain tasks that were performed well, and others that were not performed well, it is relatively easy to find the likely competence state this person is in. If a person consistently performs well in tasks 1, 2 and 7 in the above example, but fails to perform well in task 4, this would mean that competency A (*Knowledge about actors, tasks, goals and resources*) would be a relevant learning goal. In case of such discrepancies one could provide the person with tailored learning contents.

This competency diagnosis can make use of the adaptive potential mentioned previously. From knowing that a person can perform well in certain tasks, it can be inferred with some certainty that this person also performs well in other tasks. This seems to be especially relevant for structures that encompass a large number of tasks where it is unlikely that performance information about all tasks is available for each and every employee.

Judgments of whether a certain task has been performed well or not (performance appraisal) can be obtained in a number of different ways. Standard procedures of self- and supervisor rating known from competency management and other Human Resource instruments (such as assessment centers or performance appraisal schemes) can be obtained. An important advantage when compared to many of the standard practices is that appraisal can be based on task performance which is relevant for the job that is being performed. This avoids several biases known from the appraisal of competencies (Schmitt & Chan, 1998).

The procedure of diagnosing competence states from past performance, and especially the adaptive procedures, require that the structures are valid. This is not an exclusive requirement for our approach, but in fact is essential for any appraisal system that is being put to use (see e.g. Schmitt & Chan, 1998). A special benefit offered by the competence performance approach is that it makes validating easier and offers the opportunity to integrate validation directly into the modeling or assessment process (Ley & Albert, 2004). Criteria for validating competence performance structures are discussed in Ley, Albert & Lindstaedt (in press). In the present case study, an initial comparison of the assignments done by the two experts resulted in an agreement coefficient (inter-rater reliability) of $r=0.26$ for the *HAM* stream and $r=0.53$ for the *SGM* stream.

Conclusions and Outlook

The above structures map the learning domain in terms of learning goals and the related tasks directly derived from relevant working tasks. This means that learning is specifically tailored to the requirements of working tasks and processes. We are currently also examining other elements of the user context that can be of use when providing process learning support, namely the process context and the application domain (see Ulbrich et al., 2006). We expect that by integrating competence performance structures (as well as other elements of the user context) into a user profile component, the retrieval component of the APOSDLE system will be able to better tailor the retrieval of existing resources to current available and missing competencies of the user.

In terms of structuring available content, competence performance structures provide an overall map of the learning content. Moreover, the use of competencies makes it possible to structure single learning resources according to the underlying knowledge need. We are currently researching ways to construct learning material automatically from available content that is structured by a “learning template” (de Jong, van Joolingen, Veermans, & van der Meij, 2005). The structure of the template and content of the material is dependent on the learning goals of the user (derived from the missing competencies), as well as the type of missing knowledge. For example, competency A (“Knowledge about actors, tasks, goals and resources” in Table 1) is mainly based on conceptual knowledge, whereas competency C (“Knowledge of building the Context Model”) is mainly based on procedural knowledge. As a consequence, the structure of the template will be different for learning something about competency A (e.g. learning definitions, background of terms etc.) than for competency B (learning procedures using how-tos and worked out examples).

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Identification of User's Learning Goals in Workflows

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Abstract. Nowadays, the main focus of business process management research is concentrated on keeping the enterprise business processes up to date and conform to the enterprise business goals. The fact that enter- prise employees need to adapt to the new process flows, efficiently make decisions in a new situation and apply recently emerged technologies is often left without attention. The authors of this work argue that the methods of goal oriented adaptive e-learning will help employees to solve the problem of being informed up-to-date and competent without taking off work. The paper presents a method for employee's learning goal elicitation during their work with the enterprise workflow management system.

1 Introduction

Once,Workflow Management Systems (WFMS) [Allen 05] were intended to support the enactment of the enterprise business processes and to guarantee the quality of process results. However, the modern world sets harder requirements to business process management [Scheer 05] because of the permanent changes in the economy trends and the hard competition in the global market. Changes in the enterprise workflows can lead to embarrassing consequences for enterprise employees. Examples of challenges for the employees can be the necessity to make decisions in a new situation or to efficiently use a newly emerged technology on a certain workflow step. As recent surveys [Ridge and Solis 03] show, an appreciable amount of time nowadays is being spent on looking for information on the internet, local desktop or in the corporate document repository. Although the methods and tools for efficient information search are being permanently developed [Safari,GDS], we advocate the approach of the lightweight proactive information delivery and business process oriented knowledge management described in [Holz et al 05]. In the TEAL (Task Embedded Adaptive Learning) project, we extend the idea of context-specific, proactive information delivery by using up-to-date e-learning technologies enabling just-in-time delivery of goal-oriented, user-tailored learning curricula, helping workflow participants to solve problems autonomously and competently (workflow embedded e-learning) [Rostanin et al 06]. The current paper presents a method for employee's learning goal elicitation during their work with the enterprise workflow management system which has been realized in the project TEAL.

2 Goal Orientation in Workflow Learning

In order to achieve the effectiveness of workflow embedded learning (short time and acceptable quality), two requirements have to be met by information assistants delivering the task-specific information to their users that are integrated into a WFMS: first, the delivered information has to satisfy the user's current information need (be just-in-time); second, it is necessary that the delivered information does not overextend the user (just-enough) [Rostanin and Holz 05]. Hence, the concept of goal-oriented learning is highly relevant for enterprise workflows. Let's consider an employee that is facing a new task. The employee mentally checks if his knowledge is sufficient to perform the task. If the necessary knowledge is not present a knowledge gap is identified. From this gap the learning goal "cover the knowledge gap in the context of the given task" is identified. For complex tasks more than one learning goal might be identified.

Learning goals influence the learning process in two ways:

– They narrow the range of content which is considered necessary to be learned (what to learn).

– They guide the learning process by specifying the learning strategy (how to learn).

To illustrate the notion of learning strategies, we consider the following example: A software team has to develop a client-server system using the J2EE [1] technology. The team consists of one project manager and four programmers. Neither the project manager nor the programmers have experience in programming with J2EE, so they have to learn J2EE to accomplish their task. The project manager's learning goal is to receive knowledge about the architecture of J2EE and about the advantages of the technology so that he can design the system. An overview of the technology is suitable learning content for him. The learning goal of the programmers is to learn how to program the system with J2EE. They require more detailed and specific learning content than the project manager (including exercises and examples). Even if the same knowledge is involved in both cases, the appropriate learning contents are different according to the learning goals.

According to the above considerations, we define a learning goal as a triple $g = (c, s, m)$ where g is a learning goal, c is a concept from the learning ontology (see chapter 3), s is a learning strategy and m is the user's motivation to achieve the learning goal. Typically, the motivation is a reference to the current workflow task that has to be fulfilled after the user eliminates the knowledge gap. The problem of learning goal identification can be narrowed to finding a target concept and an appropriate strategy of learning. Once the learning goal is identified and accepted by the user, it receives the following runtime characteristics: identification date, current state (not started, started, finished) and completion date. In TEAL we call an identified learning goal a *potential learning goal*. After the potential learning goal is accepted by the user it is called a *current learning goal*.

[1] J2EE: Java 2 Platform, Enterprise Edition. URL: http://java.sun.com/javaee/

3 A Method for Learning Goal Identification (Project TEAL)

3.1 Learning Concept Ontology and LeCoOnt Tool

The basis for the retrieval of the concept to be learned is the ontology of learning concepts that depicts the outline of the learning content in the Learning Content Management System (LCMS) used for workflow embedded e-learning as an information assistant. The purpose of the learning concept ontology is to model the domain of knowledge related to the given workflow. Learning objects contained in the LCMS are bound to the corresponding learning concepts using adequate metadata. The more concepts are preserved in the ontology, the finer knowledge gap identification can be achieved.

The creation and maintenance of such ontology is a long and time consuming process. To simplify the ontology maintenance, in the project TEAL there was a tool created called LeCoOnt that allows to present the ontology graphically, conveniently navigate in the ontology, search, add and change ontology concepts[2]. On the figure 1 one can see a screen of the LeCoOnt tool showing a part of the software engineering ontology that contains concept SQL and related concepts. In addition to the graphical editor, the LeCoOnt tool provides also functionality for automatic extraction of learning concepts from the online glossaries[3] that allows to significantly reduce time needed for the initial ontology creation. Later, the ontology will be continuously refined and complemented using the graphicaleditor.

3.2 Proactive Delivery of the Potential Learning Goals in Workflow

For identifying the potential learning goals of the workflow user, there was a middleware component developed called DyLeGo (Dynamic Learning Goal). The DyLeGo component can be integrated into any WFMS that provides open API for accessing the workflow context information. The workflow context includes a variety of information about the task environment that allows identifying potential learning goals:

– Task information

- Task name, description, task-relevant concepts and documents provide the key information about what the user is currently doing. Using task name we can identify potential learning goals of the user.
- Reference to the instantiated task model if the current task is instance of the certain activity model it can givemore precise information on what the user is currently doing than just using a task name.
- Project information, connection to other tasks The information about the project and other tasks (predecessor, successor etc.) of the user can help to interpret current user actions.

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[2] LeCoOnt. Learning Concept Ontology Editor. URL: http://lecoont.opendfki.de

[3] Sun Java Enterprise System Glossary. URL: http://docs.sun.com/source/8166873/index.html

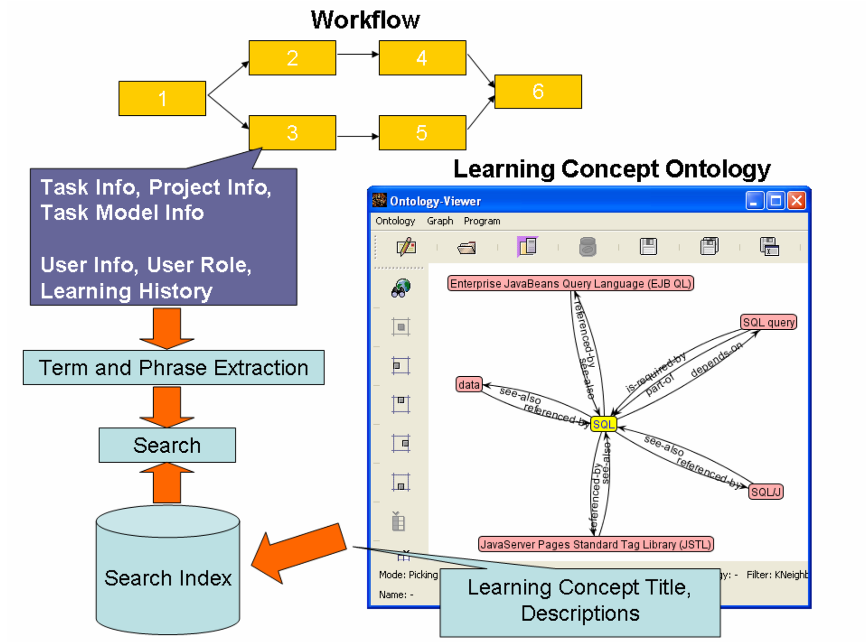

Fig. 1. Learning Goal Identification in the Workflow Context

– User information
  - User role is the base for determining learning strategy of the user (see example in 2).
  - User skills, interests, working and learning profile allow us to exclude concepts that user already knows or include concepts that are unknown for the user.

If the workflow context has changed, DyLeGo issues an automatic query containing workflow context information to the learning concept ontology and delivers a list of potential learning goals to the workflow user. The delivery is conducted proactively (push-approach) so the user does not need to start search or to specify query manually and is not interrupted in his work. To enable efficient search of potential learning goals, DyLeGo creates a text search index from the learning ontology concepts using Apache Lucene software[4] (see figure 1). The learning concept retrieval is based on extracting important keywords and subphrases from the name of the current task and its description and querying the learning concept ontology for the corresponding concepts. Found concepts are filtered using the user's learning history and his competence profile (delivered from the WFMS). The algorithm being used to determine the optimal learning strategy for the user is based on the user role in the

4 Lucene. URL: http://lucene.apache.org/

current workflow (see example in chapter 2). The database of DyLeGo contains a special table that provides information about matching between a learning concept, a user role and a recommended strategy. The contents of the table is initialized by the authors of the learning concept ontology who can make recommendations about the usefulness of the corresponding concept for every role. During the usage, the system learns which users prefer which strategy and the information about concept-role-strategy matching is being automatically updated. Other information used for specifying the learning strategy is user's skills, interests, working and learning history. In the TEAL project the following learning strategies were identified:

– **overview** Very short description giving the general impression about the subject to be learned. One can compare this with glossary description. On the basis of the overview Bob should be able to judge whether he needs to learn this subject deeper or not.

– **cursorily** If the learner decided to learn the subject but he/she does not need to get expert-level knowledge on it, the cursorily strategy should be chosen. For instance, it would be the case if Bob's manager would like to get acquainted with possibilities of the SQL language.

– **detailed** Provides expert-level knowledge on the subject. If Bob would like to optimize a complex Oracle query and has no idea about optimization, a detailed course on Oracle SQL tuning should be delivered for him.

– repeat Serves as reference material on the subject. If Bob finished the course on Oracle SQL tuning he might still need a succinct reminder course on Oracle optimizer hints. The above listed strategies were oriented on the learning course generator [Ullrich 05a] developed in the LeActiveMath[5] project and used in TEAL for dynamic goal-oriented course generation. In the future, the list of strategies will be extended and should cover the Bloom's learning goal taxonomy [Bloom 56].

4 Conclusion

This short paper introduces a simplified model of goal oriented learning in enterprise workflows and presents a method for user's learning goal elicitation in the workflow process. The proposed method is a lightweight approach based on the assumption that most of the concepts used in the current workflow are modeled in the learning concept ontology. It also assumes that users give names to the current tasks according to certain naming conventions (e.g., the name of the task starts with a verb etc.). In order to sophisticate the presented approach, further research and evaluation is currently being conducted.

The feasibility of the proposed method was proved during the TEAL project. In the project, the DyLeGo system was successfully integrated into a flexible workflow engine called TaskMan that was developed at DFKI[6]

[5] LeActiveMath. URL: http://www.leactivemath.org

[6] FRODO Taskman. URL: http://www.dfki.unikl.de/KM/content/e179/e506/index_ eng.html

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A Framework for Building Virtual Communities for Education

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Abstract. The aim of education is to provide the basis for life long learning and improvement. In this direction, schools and universities offer standard curricula aiming to cover the fundamental needs of their students in a few years scope. On the other side, institutes and companies offering life long education focus on improving specific skills and competencies of people in a short period of time. Obviously the aims, capabilities and availability of attendants vary significantly, since they usually have to cope with their morning work and their family duties. As a matter of fact, several issues, such as the limited duration of training programs, the loaded schedule of trainees, the inevitable absences due to other obligations, the multitude of topics to be covered, the variance of attendants' interests and needs, have to be considered in order to create a competitive training program. In order to support attendance and inform people on the topics, requirements and aims of programs we need a flexible program structure and an infrastructure that delivers information, training material, and support on demand, in a daily basis. We believe that a single institute is not always capable in coordinating such a composite effort and we capitalize on the building of a virtual community for education. Community will comprise training institutes, educators and trainees who will interact and co-operate in order to achieve maximum gain and flexibility.
Keywords: Virtual communities, education, life long learning

1 Introduction

The evolution in networks and hardware and the advances in software integration, allowed educational institutes and organizations to join forces and offer advanced courses to people. In the same time they have the infrastructure required to monitor and support students either from distance or in contact. In the same time the work performed in educational standards and course design software [13],[14] allows educators to build modular educational material and exercises and compose flexible course scenarios [10] and programs [6] that fit to every student's needs.

In the scope of life long education, people search for training opportunities in order to cover their needs at work, enhance their skills' profile and shift or push their career. On the other side training institutes strive to find space, time and people (educators) and organize them efficiently. Educators should have profound knowledge and be capable to teach multiple topics, classrooms should be available and well equipped all the time in order to support a group or a single student. The institutes must provide flexibility in the delivery of training programs which could last from a weekend to a few months. The same topics should be covered, although in a different level of detail. Finally, institutes should provide side-support, offer additional material and exercises to trainees and give them the ability to demand new programs.

For all the above reasons, we consider that a flexible framework for offering education and training is crucial for life long learning. A ***community framework*** will allow the collaboration of institutes and management of trainees and training programs and will facilitate the cooperation of educators and trainees. In this paper we present the main directives for developing a virtual learning community, which incorporates educators, trainees and institutes and offers reading and training material and packaged training solutions. We discuss the main issues concerning the design, operation and administration of this community and focus on the features and services it should offer. We present technical solutions with minimum cost and portray the merits of this approach through the prototype application of a virtual learning community for a postgraduate programme.

The next section presents the fundamental concepts of contemporary education and virtual communities and is an introduction to the framework presented in section 3. Section 4 illustrates the prototype application of this framework into a virtual community of postgraduate students and focus on implementation details. Section 5 discusses major operational and administrative issues of our prototype that apply to all virtual learning communities. Finally, section 6 summarizes the gains of the community approach for institutes, educators and students and provides useful insights for the success of a larger learning community.

2 Fundamental Concepts: Education and Communities

Life long education covers a wide range of ages and comprises all official, unofficial and informal learning methods [12]. It also refers to any learning activity through life that aims in improving knowledge, skills or dexterities. Education can be supported or not and support can be provided in vivo or from distance. The motive behind this personal improvement is either social or professional or both [1].

In **distant education**, the reading material, courses and support are offered using network technologies to distant students all over the world [5]. The supervision and guidance of students in real-time is optional, however the duration, the educational targets and the tasks to be performed are predefined.

In **open education** all learning tools and materials are available to the student. The syllabus, tasks and targets of a program can be modified at students' will. In open education, autonomous learning is favoured [9]. Moreover, students' needs and capabilities affect the structure, duration and tempo of an educational program. Open education can be delivered from distance or not, is delivered to groups or single students and allows students to interact with the programs' structure. The term 'open' has a second meaning, referring to the ability of anyone to participate in a program.

Virtual communities (or internet communities) are defined as groups of people with common interests and practices that communicate regularly and for some duration in an organized way over the Internet through a common location or mechanism. **Virtual learning communities** share many features with the prementioned concepts [7]. First, all community members have a common interest: education. Second, Internet is the carrier and network technologies the supporting infrastructure. Finally, the idea of 'open' is tightly related to virtual communities, since anyone interested in education is a potential member for an learning community, and is likely to communicate his/her opinion to other community members.

A review of the existing solutions in education reveals the power and flexibility of communities [8]. The undeniable gain from using communities in education springs from the increase in membership. However, increased participation results in augmented administrational and operational costs and risks. Since the main aim of the community is defined, the next step is to define the community borders: the contributors and members, the roles and rules of the community. In the following, we present in more details the framework for establishing a virtual learning community.

3 A Virtual Community for Education

The success of a community is measured in the degree of its members' participation. Since the members carry all community tasks, the definition and assignment of roles, duties and rights to members is crucial. In opposition to virtual enterprises and organizations, the definition of rights and responsibilities in a community is not strict and changes according to members' need and participation. Active and capable members of a community are promoted or assigned new roles. Members that do not contribute are restricted, demoted and set aside by other members. Potential members of a learning community are students, people that need training, trainers and tutors, researchers seeking to exchange knowledge, universities and institutes that offer training and companies that produce educational material and software.

The building blocks of the community are ***students*** or ***trainees***. They join the community in order to attend an educational program and obtain knowledge. They request for training in side fields unrelated to their studies and receive support and guidance by other community members or experts. ***Universities*** and educational ***institutes*** are the community motors. They assemble educational modules into targeted programs and guide students and trainees to improve skills. They undertake the administration of the community and in parallel monitor and facilitate members. They study the members' needs, design and offer courses and direct members to the appropriate knowledge. Individual ***educators*** and ***researchers*** are able to offer their expertise to the community, always under the administrators' control. The anatomy of a learning community is depicted in figure 1 and explained in the following.

In order for the community to thrive, the harmonic cooperation of all members must be achieved. The system should consider the particular needs and targets of life long learners [3]. The community should be able to adapt content and courses to the match changes in the work environment and rapid technological expansion. A ***profile base*** where members' skills, needs and educational targets are recorded is very useful in the design of new courses or seminars. The analysis of members' profiles will give better educational solutions and create competitive groups of learners.

A "***knowledge base"*** [11] will contain educational material organized by topic, course scenarios, educational solutions, program evaluation reports, answers to users' requests etc. Educational programs must comprise reusable learning objects that can be easily recomposed or transformed to fit each employee needs. The use of learning objects facilitates the monitoring of content, since it is easier for institutions to rate the quality and suitability of content uploaded by educators. Additional training material can be added by authorised members, only after evaluation.

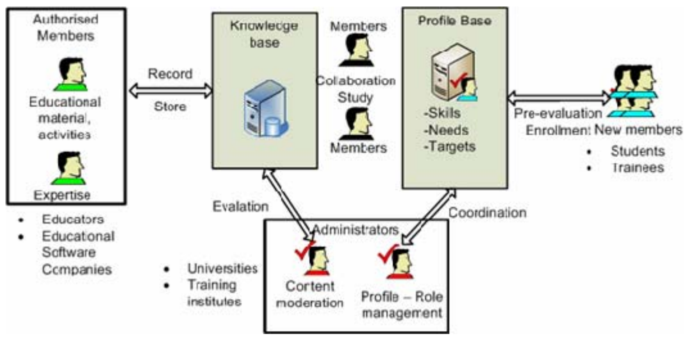

Fig. 1. A learning community

Finally, the power of the community resides in the ability of members to collaborate. It is essential in this case to build a ***collaboration environment*** and encourage members' interaction through group activities. In such activities, distant members of a virtual class are forced to communicate, to participate in synchronous activities, to split composite activities into tasks and work in subgroups etc.

4 A Prototype Virtual Community for the Education

In order to strengthen our belief on the power of virtual communities in education we established a community supporting a postgraduate program held in our university. The program, was entitled "Virtual Communities Socio-psychological Issues and Applications" was a joint effort of the university with one technical university and one research institute. Tutors from the three institutions had different theoretical background (psychologists, sociologists and computer scientists) and orientation and the same happened with the students. All courses were performed at the university place, whereas tutors could be in distant places. The community members were divided into professors and students. However, administrative and coordination tasks were held by the registrar.

In order to advertise the program we created a web site with general information. Additional information concerning every day activities of each course, news and announcements of interest to the students were hosted in a free web space server (web log) and only registered community members were allowed to update or comment. In an effort to delegate administration tasks, we created what we call the "weblog umbrella" (Figure 2). Web logs are easily updatable websites where administrators can post messages by filling a few forms and without special knowledge on web design technologies. We created separate web logs, hosted into free web servers, one for each course. The ***course tutors*** could add short notices or announcements and manage the comments or posts of the community members. The ***students*** were permitted to comment on the tutor notices thus providing them with useful feedback. Weblog ***visitors*** were able only to read announcement or comments. On the top of this set of weblogs we created an additional weblog for the whole program, in which community members were able to post messages. The program web log was accessible for the program web-page and provided links to all program courses.

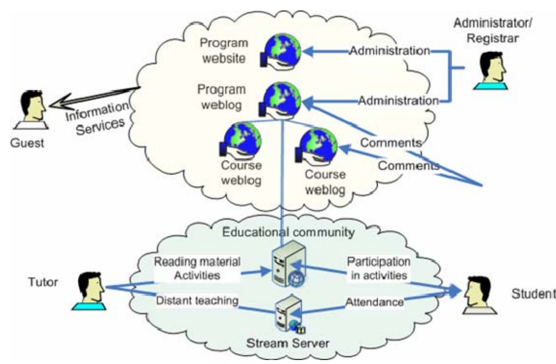

Fig. 2. The prototype learning community structure

The main educational activities of the community were supported by an open-source web application (Moodle: http://moodle.org/), which was accessible for students and tutors. In the majority of courses tutors used the community application solely for provided reading material to students. However, in several courses, students and professors employed the forum, chat and news services in order to coordinate their actions. We have completely tested the activity services provided by the application, which is on our plans for the upcoming semester.

Finally, using the technological infrastructure of the university's teleconference room we performed distant courses from one of the joint institutes. Tutors and students were interacting using real-time video over a streamed media server.

4.1 Applied Course Scenarios

In the scope of the post graduate program, we setup several educational activities for the students and employed as many of the community software facilities as possible. In a certain course we asked students to form subgroups in order to carry out the assignments. Using the "Form sub-groups" option of the software we divided students into teams that could discuss the assignment issues in private. Although, all the other students were not able to watch the private discussions, the tutor could monitor the activities and coordinate each group.

In another course, students were provided with individual weekly assignments. In order to provide additional support for the assignments, the tutor arranged an online group meeting once a week with all his students. During the online meeting the tutor answered questions, provided consults and gave directions.

Apart from the course activities, tutors used the poll services of the community in order to trigger their students' interest. The students used the same services in order to perform surveys among their classmates and visitors.

5 Administration and Operation

In this section we present a walkthrough for the design of a virtual learning community according the aforementioned framework, and based on our experience from the program.

5.1 Roles

The first step is to define the members and their roles. As explained in section 3, anyone can be a member in an open community. More specifically, ***student-members*** should provide their educational profile in detail in order to be accepted. A pre-evaluation procedure will give educators a better view on members' knowledge and skills. Universities and institutes are expected to provide the community with content, guidance and support. As a consequence, ***administrators*** are selected from these institutions and are responsible for managing members' profiles and evaluating content. Some ***tutors*** are assigned with the task of producing new educational material upon request. The same people carry out a ***moderator*** role in the community services. Additional material can be obtained from volunteers out of the community borders.

Apart from the educational subjects, members need technical support on the use of the community services. The technical staff of the institutes will initially become the community ***facilitators*** [15]. However, regular community members with technical expertise can be accredited this role. The role tasks comprise the editing of help files or user manuals, the answering of frequently asked questions and the response to members' requests for help. Facilitators will help new members, either students or tutors to get accustomed to the community services and take full advantage of them.

5.2 Services

The community must build a gateway for people or companies outside its borders that wish to cooperate with the community. ***Information*** services are the front-end of a community. A web site with informative material on the community activities, sample courses, contact information and a feedback form will allow companies or individuals to offer content and potential students to reach and join the community.

Simplicity in the use of services is another factor that increases participation. New members are attracted by an easy interface and request for more advanced services only when they become accustomed to the community. Unfamiliar members can easily become disappointed by complicated services and leave, unless they have the proper support. *Support* is another important factor for a successful community [2]. It can be established by providing informative material to members (online tutorials, manuals, frequent questions and answers etc.) and by assigning guidance roles to selected existing members (facilitators, moderators etc.). ***Communication*** services (synchronous or not, private or public) are vital to all community members: to educators for coordinating their collaborators, guiding and supporting their students, to students for discussing about assignments and requesting help on activities.

Collaboration services are very useful when they are coupled with educational activities. A group project turns autonomous learning into a collective activity and helps students to improve their analytical and collaboration skills. An activity, which flourishes in educational and knowledge sharing communities are wikis. A wiki is the collaborative coverage of a topic from the members of a community. Any member can contribute or modify the content under conditions (proper reason, provide references etc.). Other collaboration services comprise, virtual workbenches, virtual blackboard etc. The results and history of collaboration services are usually stored and used as a reference by other community members.

5.3 Operational Issues

The aim of the community is to help members improve their profile. It is essential for educators that the students profile is real and that their virtual identity is consistent. ***The validity of the educators' profile*** information is also crucial for students [4]. Since educators have a mentoring role, it is important that they definitely posses the knowledge and skills they declare. The ***validity of content*** is strongly connected to the quality of the community and should be considered wisely. The administrating institutes are responsible for the validity of both educators and content. An authorization mechanism is sufficient to guarantee the constant member identity and to protect community from unauthorized users. Administrators are responsible to continuously monitor the freshness and usage of content and in parallel test the capability and knowledge of tutors in order to proceed with updates. They should also build the students' profile and analyze the profiles evolution in order to create and suggest new training programs.

A usually neglected aspect of virtual communities relates to their expansion plan. The expansion in the structure of a community can be bi-directional: a) ***sub-groups*** can be formed inside the community, thus increasing its complexity and the need for internal management and administration, b) ***new members*** can be added, thus expanding the borders of the community. The creation of sub-groups is an additional burden for the administrators of the community. Although the existence of sub-groups generates the need for additional services and increases managerial tasks, it is essential for educators and students to work in harmony. The self-administration of sub-groups is more convenient for the administrators of the community, however limits control over the group activities.

6 Conclusions – Benefits and Future Work

The gains from the use of a virtual learning community are many for universities and students. Students have the ability to exchange empirical knowledge while carrying out learning activities. Tutors can increase the consultation time through forums, they share their knowledge and contribute to the guidance of members more easily. When communities are in contact with companies, they receive information on new products and reading material thus promoting professional excellence of educators. As a result members work smarter that harder, communicate expertise to new members and acquire maximum benefits. The benefits from the use of communities are the main motive behind the participation. The benefits for the educational institutes are mostly organizational and strategic. They cooperate, expand their borders, advertise their programs easier and with minimum cost and increase their potential students. Universities are the focal points of the community, since they provide support and guidance, and they define key knowledge areas.

It is in our next plans to increase the activities of our community and create new educational scenarios that fully exploit the community infrastructure. We have already planned several wiki activities, which we expect to activate students in a daily basis and interact with each other frequently. In the same time we intend to analyse the users' behaviour inside the community in order to detect what is attractive and what is not for the students, what possible flaws in courses result in decreased participation and finally to evaluate the usability of the provided services and interfaces.

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Personal Learning Environments: Challenging the Dominant Design of Educational Systems

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Abstract. Current systems used in education follow a consistent design pattern, one that is not supportive of lifelong learning or personalization, is asymmetric in terms of user capability, and which is disconnected from the global ecology of Internet services. In this paper we propose an alternative design pattern for educational systems that emphasizes symmetric connections with a range of services both in formal and informal learning, work, and leisure, and identify strategies for implementation and experimentation.

1 Introduction

Abernathy and Utterback introduced the concept of dominant design in 1978 [1] to describe the emergence of a broadly accepted core design principle from a number of competing incompatible alternatives.

Common examples are the QWERTY keyboard, the VHS video standard and the IBM PC. The primary characteristic of a dominant design is that, once it emerges, innovative activity is directed to improving the process by which the dominant design is delivered rather than exploring alternatives.

A dominant design may persist for a considerable period of time, even though it might not represent the best technical solution (e.g. VHS v Betamax).

Within the field of education technology, the focus in recent years has been on the improvement of the technology of the virtual learning environment (VLE, also known as a Learning Management System, or LMS) with software and techniques that do not fit the general pattern of capabilities of a VLE being largely marginalized.

We have seen the emergence in recent years of substantial product improvement, of mergers and consolidation (e.g., the merger of WebCT and Blackboard), standardization and conformance regimes (e.g., IMS [2], SCORM [3]), and major investments made in open-source versions of VLEs (Moodle [4], Sakai [5]).

However, in this same time period several other innovative technologies – peer to peer systems, weblogs, wikis, and social software – have at the same time been both widely adopted and used by a varied and diverse number of people, yet until very recently been marginalized, unsupported and even in some cases banned [6] within educational institutions, despite increasing conviction amongst some education technologists (e.g., Downes (2004) [7]) that they represent something closer to the generally lauded ideals of lifelong and personalized learning.

If we accept the notion that the VLE represents a dominant design, then perhaps we can also consider the possibility that there lies within the alternatives the possibility of a new design which represents not just a refinement of the design but an entirely new design pattern which could offer a very different set of possibilities, better reflecting the needs of lifelong learners.

Current systems used in education follow a consistent pattern, one that is typically referred to as a Virtual Learning Environment (VLE, fig. 1.) within the context of UK education (and termed a Learning Management System (LMS) elsewhere).

This pattern describes a particular category of software that has reached near saturation within the UK educational system [8], from which we might justify describing the VLE pattern as the dominant design of educational systems.

2 Characteristics of the Dominant Design

2.1 Focus on Integration of Tools and Data within a Course Context

The general design of a VLE follows a consistent model of integrating a set of tools (forums, quizzes) and data (students, content) within a context of a course or module. This pattern follows the general educational organizational pattern of modularization of courses and the isolation of learning into discrete units. This design pattern is very prevalent; in some VLE products it isn't even possible to share content between course spaces within the same system.

2.2 Asymmetric Relationships

Within current learning systems there is often a very clear distinction between the capabilities of learners and of teachers. In particular, the tools to organize and create are richer for the teacher than for the learner. This asymmetry sends a conflicting message to users; on the one hand they are exhorted to be creative, participate, and to take control of their learning, and on the other they are restricted to a primarily passive role, where what contributions are possible are located first within the small slice of their overall learning represented within the VLE, and then further by the slots within the existing structure of information organization presented within the VLE.

2.3 Homogenous Experience of Context

The course-centric organizational model and the limits on learner's ability to organize the space combine to create a context which is greatly homogenous; all learners have the same experience of the system, see the same content, organized in the same fashion, with the same tools. This replicates the general pattern of education that places emphasis on the common experience of learners within a context. This contradicts the desire often expressed under the general heading of lifelong learning for an individualized experience tailored to personal needs and priorities.

2.4 Use of Open E-learning Standards

Alongside the VLE a parallel development process has taken place, creating a set of standards and specifications to assist in the integration of VLE products into management systems (e.g., the IMS Enterprise and Enterprise Services specifications), for incorporating packaged learning materials (e.g. SCORM, IMS Content Packaging), and for incorporating automated assessments (e.g. IMS QTI). These have been adopted by VLE vendors and requested by customers and industry groups, and have further stabilized the design of systems around compliance with these core platform standards.

However, other specifications, such as RSS [9], that have achieved widespread adoption outside education have not directly impacted the VLE; this is at least partially a side effect of the closed nature of the products, which discourage open sharing of content.

2.5 Access Control and Rights Management

The VLE typically restricts access to content and conversations to the cohort engaging in a unit, and through arrangements with publishers acts to safeguard licensed content from external view. This restriction acts against the drivers of lifelong and lifewide learning, which seeks to unite the experiences of learning in the workplace and home, and of cross-organizational learning. Most content within a VLE is not available to the outside world; it is also often unavailable to learners after they leave a course.

2.6 Organizational Scope

The scope of operation of a VLE is typically the organization that installs and manages the software; a service-based model is supplementing this where systems are hosted for organizations by vendors on their behalf. However, the scope of operation is still organizational in that the scope of information managed by the system is the management information of the organization. Typically a VLE makes it difficult to engage external organizations, and learners who are not registered in some fashion with the organization. Again, this is in opposition to the lifelong and lifewide learning model where there is an important role for cross-organizational learning and informal learning.

More interesting are hybrid models emerging such as the Blackboard model of creating a network of systems enabling better coordination amongst organizations using Blackboard. However, the scope of operation is still limited to organizations using the same platform, and so the problem of isolation remains.

3 Characteristics of an Alternative Design

The critical design flaws inherent in today's learning systems can be addressed through adopting a new design pattern that shifts emphasis away from the isolated experience of the modular VLE. We characterize this new pattern a Personal Learning Environment, although unlike the VLE this is primarily a pattern concerned with the practices of users in learning with diverse technologies, rather than a category of software.

The discourse of PLE began to emerge from conversations amongst a diverse group of educational technologists in early 2005, and in particular momentum began to build when Wilson published a conceptual model for a new type of system, termed at the time as the "VLE of the future" (Wilson, 2005 [10]). An updated version of the diagram is presented here to illustrate the possibilities of a PLE (See Figure 1.)

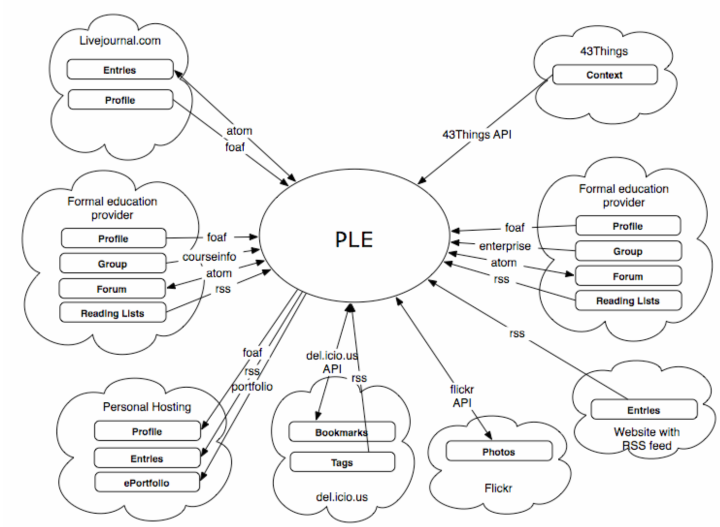

Fig. 3. Conceptual model of a personal learning environment, a development of the model by Wilson (2005)

3.1 Focus on Coordinating Connections between the User and Services

Rather than integrate tools within a single context, the system should focus instead on coordinating connections between the user and a wide range of services offered by organizations and other individuals. Rather than interacting with the tools offered within the contexts supplied by a single provider, the PLE is concerned with enabling a wide range of contexts to be coordinated to support the goals of the user. This is more consistent with a competence-oriented approach to learning, and explicitly recognizes the need to integrate experiences in a range of environments, including education, work, and leisure activity.

3.2 Symmetric Relationships

The system should be rebalanced in favor of symmetric relationships; any user should be able to both consume and publish resources using a service, and users should be able to organize their resources, manage contexts, and adopt tools to suit their needs.

3.3 Individualized Context

Given the focus and nature of the relationship with the system, it will no longer be possible to provide a homogenous experience of a context outside the scope of closed systems, as users can re-organize the information within the context as they see it in any fashion and choose the information and tools to situate within it.

3.4 Open Internet Standards and Lightweight Proprietary APIs

Because the scope of the system has expanded beyond the services offered by institutions, the range of standards and protocols used to interact with services increases, and it is no longer possible to focus solely on standards developed to suit the needs of the education sector. Instead, systems will need to interact with services offering their own proprietary APIs (for example, Google Maps [11]) and with services offering interfaces that support more general web standards (for example, IETF Atom [12]).

From the perspective of the PLE, connection is far more critical than compliance, and it is far better to offer a wide range of services, requiring support for a range of standardization from formal standards through to fully proprietary (yet publicly available) APIs, than to restrict the connections possible to users.

3.5 Open Content and Remix Culture

Unlike the VLE, the PLE is concerned with sharing resources, not protecting them, and emphasizes the use of creative commons licenses [13] enabling editing, modification, and republishing of resources. Rather than pre-packaged learning objects, the resources collected and accessed using the PLE are more typically weblog postings, reviews, comments, and other communication artifacts.

The PLE encourages users to make “playlists” of resources and to share them with others for collaborative knowledge construction, using online services such as del.icio.us [14] and connotea [15].

3.6 Personal and Global Scope

Whereas the VLE operates within an organizational scope, the PLE operates at a personal level in that it coordinates services and information that is related directly to its user and owner. However, the PLE can also be considered global in scope as the range of services it can potentially coordinate is not bounded within any particular organization. The user can connect their PLE with social networks, knowledge bases, work contexts, and learning contexts of any size to which they can obtain access.

4 Implementation Strategies

Implementing the pattern is not straightforward, as the pattern suggests several very different strategies may be feasible. For example, a single PLE application may be possible, or on the other hand, the coordinated use of a range of specialized tools may achieve a satisfactory result. However, there are some general strategies that will be useful in many cases.

4.1 Plug-in Connectors for Services

One of the characteristics of the PLE pattern is the use of a range of services within the environment. While it may be possible to connect these services in a very minimal fashion (e.g. by screen-scraping techniques, or by just linking to them), far more interesting results are possible by utilizing a range of machine-readable services.

Primarily this can be accomplished through the use of feeds to exchange metadata; however, there are also a wide range of web APIs available from services that enable a much more interactive range of services. Crucially, these support the creation of new information and not just the aggregation of existing content, one of the major requirements of the PLE pattern.

While it is perfectly possible to implement web APIs in a piecemeal, one-off fashion, it may be more effective to elaborate a general pattern of connectors for services that can be managed dynamically and share core techniques. We term this type of reusable connector a conduit, and its main characteristics are that it provides an encapsulated service usage capability, including all the format conversion and protocol management needed to support the API, can be dynamically associated with an application, and can also encapsulate any provisioning or access control information needed to access a particular service.

An example of a conduit is the service management within the Flock [16] social browser application. Flock enables connection to a range of services including social bookmarks, blogging, and notification. The set of connections is managed using a categorized set of preferences; each individual conduit contains both the protocol information and also any required credentials.

This is especially useful in development as many web APIs, even if they begin in a totally proprietary fashion, are increasingly likely to be adopted by similar services. For example, the adoption of the Blogger API by rival services.

This implementation pattern is not just a feature of Flock. Quite independently, the PLE project at the University of Bolton [17] consciously developed a conduit pattern for their prototype service-oriented personal system, Plex [18]. Plex, like Flock, has a management interface for adding new services and dialogs for entering credentials and options

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Online, there are also examples of this pattern in a range of web applications, such as NetVibes (which offers its conduit API to other developers to assist them in developing new conduits [19]) and SuprGlu [20].

4.2 Tags, Lists and Smart Groups

To support effective organization of information, mechanisms of flexible tagging should be combined with list creation and sharing facilities. Wherever possible the acts of tagging and listing should by default be shared with a wider community through social bookmarking services. Also, rather than supporting hierarchical folder structures, the use of flexible playlist-style groups and smart groups should be considered. Smart groups are used extensively in products such as iTunes [21] and enables organisation to structure itself based on simple user-provided rules.

5 Challenges

5.1 Lowest common Factors

A PLE combines information from a heterogeneous set of services within the purview of the user; while this can be done in a fairly isolated fashion (such as an information portal) more value can be obtained by the user when the information of services is combined to enable sorting, filtering and searching.

However, given the scope of operation of the PLE, the implication is that the structure of the information operated upon will be highly diverse. This means that, rather than relying on services to offer a very detailed set of metadata using a common profile, systems will instead need to offer greater capability for managing either heterogeneous information or operate on a very limited set of information which can be commonly assumed, such as titles, summaries, and tags.

To counter the potential reduction in capability the PLE can take advantage of collaborative filtering techniques through the use of sharing “playlists”, and the use of

[1] A set of screenshots from Plex and Flock comparing the configuration of service can be found online at http://www.flickr.com/photos/vanishing/sets/72157594167600345/

rating services, reviews, and comments. The PLE needs to contribute to this process by enabling the automatic sharing of ratings and comments made by the user on resources with the wider network.

5.2 Soft Boundaries

While the contexts of formal education systems can be characterized as having bounded variety (e.g., a course typically has around 20-2000 members) and possessing rigid boundaries, general social systems used in informal learning can possess more diverse levels of variety (e.g., Goal groups in the online service 43Things [22] vary in size from 1 to hundreds of thousands of members) and have soft boundaries. For example, social contexts possess 'lurkers', transient members, and members with varying levels of commitment and visibility that makes establishing the actual boundary of a context more difficult.

Connecting with very large contexts using a PLE poses both a technical and a usability challenge, as it will not be possible to absorb all the information within the context into an environment to be operated upon locally, nor is it feasible to present users with flat representations of contexts when they contain thousands of resources.

One solution is to accept soft boundaries as being an inherent aspect of context, and to design the PLE to provide locally meaningful context boundaries for the user. One approach to supporting this is to filter the context to reduce the amount of visible users and resources based on the declared interest of the user.

To cope with large contexts, the PLE may opt to reduce the scope of representation (for example, just provide the context name and an indication of member numbers with some search tools), and encourage interaction with the context through leaving the PLE system and engaging directly with the service.

Clearly, however, the approach used in the dominant design of presenting the entire contents of a context in a fairly flat way does not scale well to handling more diverse contexts.

5.3 Effective Coordination of Groups and Teams

While social software in general has seen widespread popularity, and general social mechanisms operating across very diverse groups has been demonstrated in these open public systems, it remains unclear what mechanisms can underpin the coordination of collective actions by groups and teams within a PLE. The PLE project at the University of Bolton has investigated some mechanisms using services for coordination, and this is being further explored within the TenCompetence project [23].

5.4 Inappropriate Reification of the Design

While we have discussed the PLE design as if it were a category of technology in the same sense as the VLE design, in fact we envisage situations where the PLE is not a single piece of software, but instead the collection of tools used by a user to meet their needs as part of their personal working and learning routine. So, the characteristics of the PLE design may be achieved using a combination of existing devices (laptops, mobile phones, portable media devices), applications (newsreaders, instant messaging clients, browsers, calendars) and services (social bookmark services, weblogs, wikis) within what may be thought of as the practice of personal learning using technology.

However, for the design to reach equivalent or superior levels of efficiency to the VLE, as well as broader applicability, requires the further development of technologies and techniques to support improved coordination. Some initial investigations include the work of projects such as TenCompetence and the Personal Learning Environments work at the University of Bolton cited previously.

5.5 Living with Existing Systems

It is one of the invariant laws of technology that any new system must co-exist with previous systems, while that in the case of education the VLE pattern should lose, eventually, its status as the dominant design, the technology will be around us for a long time to come. So how will the PLE and the VLE design co-exist? This can simply be a case of parallel lives, with the PLE becoming a dominant design in the space of informal learning and some types of competence-based learning, with the VLE remaining the key technology of formal educational systems. Alternatively, we may see a period of connection, whereby VLE products start to open their services for use within the PLE. However, we may also see a pattern of co-opting, whereby the characteristics of the PLE are incorporated into the VLE, yet along the way robbing them of some of their transformative power.

We are seeing some evidence of all three strategies. We have an emerging discourse of “elearning 2.0” [24], new tools for competence-based learning in projects such as TenCompetence, and also of existing VLEs adding features such as weblogs and Wikis.

6 Conclusions

The VLE is clearly the dominant design in educational technology today, and is nearly ubiquitous in higher education institutions. However, its hegemony is being challenged, partly from within education by the desire to bridge the worlds of formal and informal learning and to realize the goals of lifelong learning, and partly from outside education by the increasingly prevalent forms of social software and the new paradigms of the web as technology platform.

The VLE is by no means dead, and those with investments in this technology will attempt to co-opt new developments into the design in order to prolong its usefulness.

It is however the view of the author that the key distinctions between the VLE and the PLE are of a more conceptual nature than one purely of features, and that ultimately alternatives such as the PLE model will develop in sophistication, making the VLE a less attractive option, particularly as we move into a world of lifelong, lifewide, informal and work-based learning.

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