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Social Software for Life-long Learning

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PROLEARN Network of Excellence

ABSTRACT

Life-long learning is a key issue for our knowledge society. With social software systems new heterogeneous kinds of technology enhanced informal learning are now available to the life-long learner. Learners outside of learning institutions now have access to powerful social communities of experts and peers who are together forging a new web 2.0. This paper reviews current work in pan-European initiatives that impact upon life-long learning via views of professional learning, learner competence and social networking. It seeks to provide an overview of some of the critical research questions for the interdisciplinary field of social software research.

Keywords

Social Software, Life-long Learning, Learning Networks, Blogs

Introduction

Life-long learning (Aspin & Chapman, 2000) refers to a society in which learning possibilities exist for those who want to learn (Fischer, 2001). Learning is not restricted to the classroom and to formal learning inside learning institutions, it an activity which happens throughout life, at work, play and home. In the modern knowledge-intensive era, life-long competence development has become a major challenge to our educational systems that have not changed their educational policies and pedagogical models to support life-long learning. There is an increasing demand for new approaches towards fostering life-long learning perspectives. Emergent Web 2.0 concepts and technologies are opening new doors for more effective learning and have the potential to support life-long competence development. For life-long learners the first generation Internet allowed easy access to a vast range of published materials. The second generation Internet allows them to contribute to it. This ability for new life-long learning communities to participate and create the new web has lead to a whole generation of new 'socially based' tools and systems that are generically referred to as social software. Social software can be broadly defined as tools and environments that support activities in digital social networks (Klamma et al., 2006; Chatti et al., 2006a). Digital social networks are social networks mainly realised by means of computer-mediated communication (Licklider et al., 1968). Most social software research (Wellman et al., 2002; Shirky, 2003) concentrates on the relations between social entities in digital social networks and their interaction, while community information systems contain and group social entities.

For the life-long learner who is learning at work or at home, outside the context of a formal institutional learning programme, the initial problem of access to powerful learning materials has been significantly improved by the world-wide-web. This first generation Internet has allowed institutions to publish materials with ease and made them accessible to all learners. However, until relatively recently the critical difference between those inside learning institutions and those outside was in the access to a ready-made learning community of experts and peers. Recent - so called second generation Internet - developments have started to change that dynamic. Within Web 2.0, whole new communities of self-directed, self-managed and self-maintained communities have started to arise that offer compelling new forms of community. These new communities are typically open to all learners, at any point in their life of learning.

Table 1 illustrates five of the key differences between traditional Web 1.0 and new Web 2.0 (O'Reilly, 2005) knowledge management concepts for life-long learners.

In a Web 2.0 vision, the web is created by those who participate in it. The most obvious contrast is between sites which are published by institutions, such as Britannica online, and those which are maintained by an open community, such as Wikipedia. Projects like Wikipedia let life-long learners become knowledge prosumers (both

consumer and producer) and participation becomes essential for wikis replacing old-fashioned content management systems in organizations. Interoperability between content and services is realized by syndications tools (RSS). More and more web sites support RSS instead of placing a button labeled with "Set this page to your home page". It has become natural and a kind of fashion to integrate or 'mesh' third-party *web services* like google, yahoo and del.icio.us etc. Web services and syndication will be even more important in ubiquitous contexts when users need support based on their location, their connectivity, their device capabilities and their usage context.

Table 1: Differences between Web 1.0 and Web 2.0 (adapted from (O'Reilly, 2005)).

Web 1.0	Web 2.0
publishing (Britannica Online)	participation (Wikipedia)
personal websites	blogging
content management	wikis
directories (taxonomy)	tagging (folksonomy)
stickiness	syndication

An important theme in life-long learning, discussed in the projects below, is the nature of "informal and non-formal learning". Once you step beyond traditional institutional boundaries you can find learning which is driven by and for, "you, the learner". If the simplest social networking technology is blogging (Bausch et al., 2002; Blood, 2004), then the concept of 'blogging for business' has migrated out into Web 2.0 to allow significant access to new pools of experts whose views and ideas are now widely and openly available. We discuss blogs here as an example of a class of software often used in organizations nowadays, e.g. corporate wikis, social bookmarks, and RSS web feeds (Kumar et al., 2004). The term 'Blog' is a contraction of 'Weblog' and the act of 'Blogging' is the making of such logs (see for example: (www.blogger.com). Some businesses are coming to understand that 'real' news isn't just a ticker-tape-like news feed from Reuters or the BBC. In business, the most significant news is what you and those you have reason to care about, did yesterday, are doing today, and plan to do tomorrow.

Essentially, blogging tools and portals have become a significant focus for a trendy vision of community publishing outside institutional boundaries. They allow users to quickly generate simple web pages and link to others, directly from within a public web page. In their simplest form they are used as stream-of-consciousness public web diaries or activity logs, hence 'weblogs'. They don't require expertise to use, they capture and share text easily and can even be extended to include images, sounds and movies. Members of your community can "subscribe" to blogs and upload comments to them – and even vote on the significance of the entries. In this way, this simple and yet pervasive set of tools has formed a large number of significant public "communities of practice" (Wenger 1998) around the bottom-up drive of community members.

Empirical Studies on Blog Uses in Online Learning Networks

In this section we delineate two empirical studies about blog uses in online learning networks of two different contexts, namely corporate and in higher education. The former addresses the incentive mechanism underlying blog usage of corporate learners and is part of the project **Learning Network for Learning Design** (LN4LD), whereas the latter analyzes how blogs have been deployed by university students and is part of the project **iCamp** (http://www.icamp-project.org).

One of the major features of blog is the "reputation management" of participants. Indeed, we have recently seen the emergence of so called "Ghost Blogging" services for companies who want more professional marketing and support of their blogging output. Blogs can show participants' daily engagement with key issues. Participants can gain significant reputation in their community by "being seen" publicly creating valuable artefacts that is of use to new members of their group. The individual satisfaction and perception of effectiveness in that sense is closely related to the commitment of the individual to contribute and actively participate.

We perceive adaptivity and personalization as key issues for implementing mechanisms to foster and increase activities in lifelong learning networks. Currently an integrated approach that allows rewarding and incentive mechanisms on different levels of sharing and exchanges is researched in the **TENCompetence** project. A main critical point in building social software that is actually used and in developing communities that become active learning networks (Koper et al., 2005) is the engagement in the sense of active participation and contribution of the individuals.

Today's life-long learners are in constant need to update knowledge and competences, given certain personal or employment-related motives (Aspin & Chapman, 2000; Field, 2001). Online, distributed life-long facilities can be designed that cater for these needs at various levels of competence development. However, merely introducing such facilities will not suffice. Potential learners should also be motivated to actually use and actively contribute (Fisher & Ostwald, 2002). So called 'free-riding' or lurking' is considered to be one of the main problems in online learning. To some, the encouragement of employees to contribute knowledge is even more important than the more technical (interoperability) issues related to its capture, storage and dissemination (Boisot & Griffiths, 1999). What might then motivate an individual to participate actively in a learning network, to respond to others' questions, to contribute content, complete activities, carry out assessments?

Experimentation with incentive mechanisms was heavily inspired by Social Exchange Theory, which informs us that participants will contribute more when there is some kind of intrinsic or extrinsic motive (or reward) involved. This theory (Thibaut & Kelly, 1959; Constant, Kiesler & Sproull, 1994) comes from the rational choice theory of economics, suggesting a relation between a person's satisfaction with a relation (i.e., with the learning network) and a person's commitment to that relation (i.e., his willingness to actively participate). It furthermore suggests four main mechanisms to motivate and encourage participation: (i) *personal access*, or anticipated reciprocity: learner has a pre-existing expectation that he will receive actionable and useful (extra) information in return; (ii) *personal reputation*: learner feels he can improve his visibility and influence to others in the network, e.g. leading to more work or status in the future; (iii) *social altruism*: learner perceives the efficacy of the LN in sharing knowledge as a 'public good', especially when contributions are seen as important, relevant, and related to outcomes; (iv) *tangible rewards*: learners negotiate to get some kind of more tangible asset (financial reward, bond, book, etc) in return. In each of the above cases, incentive mechanisms for knowledge sharing should match the spirit of what has to be achieved (Sawyer, Eschenfelder, & Hexkman, 2000). If this is finding and exchanging information about LD, research suggests that incentives to gain extra personal access to more information about LD can be expected to render best results.

When examining critical facilities for (active) participation, some exemplary studies have been carried out within a learning network about IMS-Learning Design (IMS-LD, 2003), called LN4LD. From initial implementations of this learning network, it could be concluded (Hummel et al., 2005a) that usability, simple structure, and clear policies are necessary requirements to enable participation. More specifically, we found that users should not be overburdened by complex structures and too many facilities. We also concluded that additional policies would be needed for effective exchange and active contributions. From later implementations it could be concluded (Burgos, 2006) that interlacing virtual activities with additional face-to-face meetings on the same topics yielded substantial increases in both activity level and amount of users registering. However, in this paper we would like to focus on the significant increase of active participation when introducing *incentive mechanisms* (Hummel *et al*., 2005b).

The incentive mechanism we introduced to LN4LD allowed the participants, who were interested professionals who wanted to learn more about IMS-LD for modelling / designing courses to earn points for contributions, with the reward scheme including both quantitative and qualitative components. On the quantitative side, points could be earned for: (i) forum postings (20 points for each, labelled 'pointsforpost'); (ii) replying to posts (10 points for each, labelled 'pointsforreply'); and (iii) rating of posts (3 points for each, labelled 'pointsforrate') (see Table 2). With respect to the quality of postings, contributors received additional points for: (iv) each time their contribution prompted a reply (5 points for each reply to a post, labelled 'pointsforreplyrec'); and (v) each time the originator's posting was rated (3 points * rating value, labelled 'pointsforraterec'), whereby the ratings ranged from 1 (very poor) to 5 (very good). A simple interrupted time series with removal design (Robson, 2003) was applied with (active and passive) participation as the independent variable.

Table 2 shows that most active participation points were earned by making postings to forums (320 points in total, with 220 of these being in period B). Over time, the total amount of active participation points was divided as

follows: 117 points in period A; 566 points in period B; and 141 points in period C. The average total points for active participation earned by active participants (n = 17) is 48.47 and by all participants (n = 125) it is 6.6. The repeated measures ANOVA, using time of measurement as a within-subjects factor, reveals that 'period' indeed is a very significant factor in explaining the average total amount of points ($F (2, 122) = 14.17$, $MSE = 24{,}966.08$, $p < .001$, $\eta p2 = .104$), even with the majority of participants not actively contributing. When we include 'scoring' (either 'those who did not score' or 'those who did score') as a between-subjects factor, (period * scoring) appears to be an even more significant factor ($F (2, 122) = 31.21$, $MSE = 24{,}966.08$, $p < .001$, $\eta p2 = .204$) in the linear model. It was observed that there was significant increase of both active and passive participation after introducing the incentive mechanism. Besides, choice for extra personal access as incentive mechanism was observed to be in line with the general purpose of the LN (i.e. getting more information), according to Social Exchange Theory.

Table 2: Total active participation points for each period (A-C) and parameter, for all participants (n=125).

Period	Total points	Points forpost	Points forreply	Points forrate	Points forreplyrec	Points forraterec
A.	117	60	20	3	10	24
B.	566	220	120	42	100	84
C.	141	40	30	12	35	24
A-C.	824	320	170	57	145	132

A, B and C were arranged chronologically as three equal periods of 4 weeks each
(A = baseline, B = introducing the incentive mechanism, C = removing the incentive mechanism)

Educational researchers and practitioners have invested efforts in integrating social software such as weblog into higher education. One of such initiatives is the iCamp project. Pedagogically iCamp is grounded in social-constructivist theories. Technologically it is built upon a selected set of prevailing non-proprietary technology-enhanced learning tools by rendering them interoperable. Validation of pedagogical models and technological solutions is realized through user trials. In the first trial (Oct – Dec 2006), four academic institutions from Turkey, Poland, Estonia and Lithuania were involved. There were 3 types of core actors: (i) Facilitators: four university teachers; (ii) Site Coordinators: three researchers providing support to facilitators; (iii) Students: 36 under- and post-graduates majoring in social sciences or software engineering divided into groups of four or five to develop a questionnaire. This first trial was primarily exploratory to understand how the facilitators and students interact and communicate in the online learning environment with the support of social software.

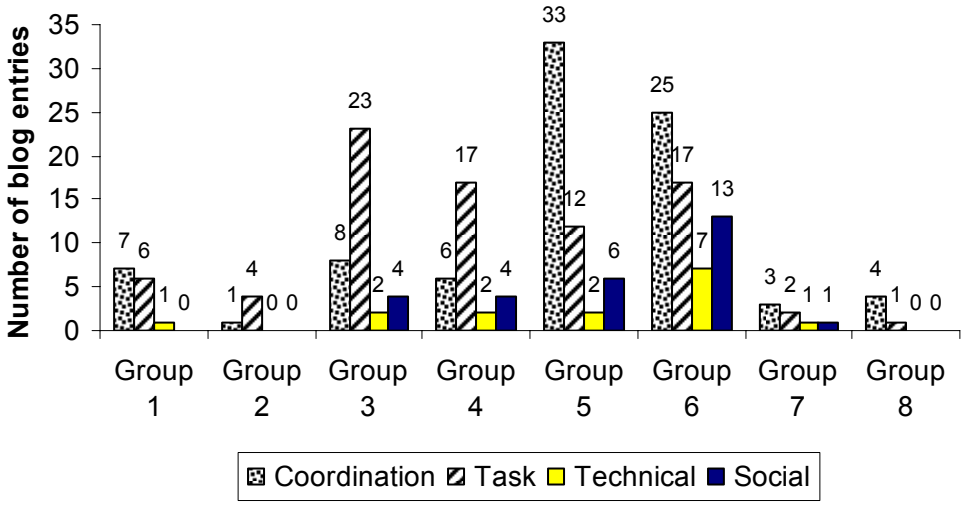

Figure 1: Distribution of content types in student group blogs

Mixed-method evaluation approach triangulating quantitative and qualitative data has been adopted. However, in such a distributed context with heterogeneous users who were basically allowed to use any of the above mentioned tools at any time in any way, it was challenging to capture real-time usage data for assessing usability and user experience. As no automatic data logging facility was installed for this trial, we relied on retrospective self-reporting techniques, i.e., structured surveys and semi-structured interviews, which have some apparent drawbacks – subjective, prone to memory reconstruction and to dilution by other extraneous data, social desirability, and missing critical incidents. Specifically, the contents of the eight student group blogs have been analyzed based on the adapted scheme of Henri (1992). Figure 1 displays the results. The average number of entries per student group-blog was 26.5 (SD = 22.5, range = 5 to 62). Note, however, the number of entries could not truly reflect the activeness of a group, which might prefer other means of communication (e.g. emails). Furthermore, four major types of entries are identified: Coordination (e.g. finding a right date for videoconference), Technical (e.g. selection of an appropriate tool), Task (e.g. ideas how to design the questionnaire), and Social (e.g. sharing cultural-specific information). It is observed that blogs have primarily been used for Coordination in most of the group.

Nevertheless, the overall collaborative experiences of the trial participants were positive, and they could also advance their competencies. There were some negative experiences related to the tools whose learnability nevertheless seemed high as the users could overcome the initial difficulty with some help and practice. Besides, most users intended to deploy this set of social software in a similar learning setting in the future. One implication for the evaluation approach is to automate data capturing; insights can be drawn from the techniques of remote usability evaluation (Paternó & Santoro, in press). The challenge of assessing the usability of social software remains high; especially we evaluate not only user interface but users interface.

Facets of Research in Online Learning Networks

Automated Metadata Generation

Social software techniques enable richer capturing of context in which content has been produced. This offers substantial potential for automating the generation of metadata ("descriptions"), e.g. by reusing metadata from artefacts produced by "close neighbours" in the social network). This sort of mining of social information can enhance the **Automated Metadata Generation** framework (Cardinaels et al., 2005). Similarly, social software based context capturing offers great potential to create advanced tools and services for dealing with the need for content. A rather simple example is to augment user queries with metadata that constrain results to those that are relevant to the context at hand (e.g. in a language that the user has demonstrated to master). A more advanced example is to alert users to relevant content, even before they are aware that it may help them in the task at hand (e.g. because the actions of their peers and colleagues have indicated that this content is relevant in this situation).

The **MACE** project (http://www.mace-project.eu) aims at making several existing learning repositories on architecture interoperable to reach a critical mass of learning resources. The plan is to qualitatively and quantitatively enrich available contents with various types of metadata – domain, usage, competence, contextual, and social. More users will generate extended usage or attention metadata that will significantly enrich the metadata created by authors and annotators. This new metadata will provide the basis for deployment of social recommendation techniques that rely on information about learner success. Attention metadata provide valuable feedback for the authors and tutors, enabling them to further improve their learning materials and experiences (Najjar et al., 2005).

Personalization and Adaptation

A **PROLEARN** (http://www.prolearn-project.org) survey has shown that a high majority of respondents considers personalization and adaptation of learning as important and crucial factors. The main reasons for positive responses are that learning should be individualized to become more effective and efficient, personalization is the key element of the learning process, and specific problems need specific solutions, as students differ greatly in their background and capabilities especially in the field of computers. Learning materials are typically too general to cover a very wide range of purposes, so personalization can be the most important added value that e-learning can offer compared to

classical learning – to optimise education, to adjust to various working conditions and needs, because students (academic and corporate) have different goals, interests, motivation levels, learning skills and endurance.

So it is generally recognized that effective and efficient learning need to be individualized – personalized and adapted to the learner's preferences, acquired competences, and evolving knowledge, as well as to the current context. Adaptive learning systems keep the information about the user in the learner model and based on it they provide certain adaptation effects. Based on the information about the learner and the current context an appropriate educational method should be chosen, which uses suitable learning activities that reference proper learning materials. This process is usually accompanied by selection of adequate tutors and co-learners. The outlined reasoning is typically based on a rich set of metadata assigned to the mentioned entities on one hand and on sound pedagogical strategies on the other. To generate the metadata and to support collaborative learning social software can play a crucial role.

In the **WINDS** project (Kravcik et al., 2004a) the consortium partners have implemented the **ALE** system, which integrates the functionality of a complex e-learning system with adaptive educational hypermedia on the Web. Several social software factors can be recognized there, especially support for conversational interaction between individuals, social feedback, as well as shifting the role of the individual from information consumer to producer. Based on the learner model, adaptive annotation and recommendation was provided. Users could assign to each learning object private or public annotations and discussions. These features enable communication between learners and tutors, and they give valuable feedback to the authors as well. The WINDS experience (Kravcik & Specht 2005) shows that teachers, even without programming skills, can create web-based adaptive courses and students can benefit from the usage of these courses. Students and teachers appreciate in the web environment what they cannot find in traditional classroom settings.

Later on the ALE platform was enhanced with services supporting mobile learning in the **RAFT** project (Kravcik et al., 2004b). The idea was to make field trips available for remote participants. Communication and data channels were established between the field and the classroom to let people on both sides not only communicate with each other but also collect, annotate, and exchange data between them. The experiment has shown that school pupils can easily understand the principles of the RAFT mobile applications and that they are able to create rich and well organized reports of field trips.

To simultaneously consider a multitude of different factors when delivering personalized learning experience is still a challenge, as an orchestration of different kinds of knowledge (concerning domain, user, context, learning activity, and adaptation) needs to be taken into account. The technological and conceptual differences between heterogeneous resources and services can be bridged either by means of standards or via approaches based on the Semantic Web. Existing standards are not enough to realize general interoperability in this area, and therefore a Semantic Web-based approach is needed to achieve reasonable results and to contribute to harmonization of available standards (Aroyo et al., 2006).

Conceptual Blogging and Distributed Opinion Publication

A major impact of the Internet has been to promote asynchronous access to online information, with traditional (client/server-based) forms of broadcasting gradually giving way to different (p2p-based) forms of "narrowcasting", such as web-casting or video blogging (vlogging). More recently, a major impact of the Semantic Web stems from the fact that its metadata has acquired the potential to become as distributed as the data it describes – with everyone being able to connect any (online) thing to any other (online) thing. This makes it possible to progress from today's opinion *registration* (opinion polls) systems to opinion *publication systems*, where the "opinionators" themselves, are in control of the exposure of their own opinions.

A **Knowledge Manifold** (KM) consists of a number of linked information landscapes (contexts), where one can navigate, search for, annotate and present all kinds of electronically stored information (Naeve, 2001a). It is constructed by conceptual modelling of a specific knowledge domain in order to capture its underlying thought patterns (mental models) in the form of *context maps*. The KMR group (kmr.nada.kth.se) makes use of this architecture in order to construct a kind of Conceptual ("human-semantic") Web (Naeve 2005), which functions as a conceptual interface to the underlying (machine)-semantic Web. This Conceptual Web can be seen as a collaborative

Garden of Knowledge - with a community of *Knowledge Gardeners*, collectively gardening their interlinked *Knowledge Patches* (Naeve, 2001a).

A **Concept Browser** (Naeve 2001b) is a constructor, an editor and a navigator of a KM. It is a knowledge management tool for collaborative overview-creation, which supports the construction, navigation, annotation and presentation of electronically stored information. A Concept Browser presents "content in contexts through concepts" and makes it possible to investigate the content of different concepts without losing overview of their context. Semantically, a concept is considered as the border between its *inside* (which contains its *content*) and its *outsides*, which represent the different *contexts* where this concept appears.

Conzilla (www.conzilla.org) (Palmér & Naeve 2005) is a Concept Browser, which aims to provide an effective collaboration environment for knowledge management on the Semantic Web. Through the Collaborilla collaboration service, Conzilla can be used for "distributed conceptual blogging", where context-maps are constructed collaboratively in different containers, with each participant in control of which containers to view and publish. This approach makes it possible to reuse and extend concepts and concept-relations published by others, and to add content and comments (metadata) to concepts, concept-relations and context-maps published by others. Hence it becomes possible to perform *bottom-up agreement- and disagreement management* in the form of *conceptual calibration* (Naeve 2005).

Confolio (www.confolio.org) is a semantic web based electronic portfolio system (Naeve et al., 2005). It is based on the infrastructure Edutella (Nejdl et al., 2002) and the frameworks SCAM and SHAME (Palmér et al., 2004), and treats metadata in a way that is consistent with the multi-purpose, subjective view on metadata introduced in (Nilsson et al., 2002). The Confolio system contains a distributed *opinion publication network*, where each portfolio owner can publish opinions on anything that has a publicly retrievable URI (Universal Resource Identifier). Such opinions are directly visible on their "annotation target", while at the same time being controlled by the "opionionator" (annotator) and stored in her own Confolio. This has powerful implications on human interaction in general, since it makes it "semantically machine-computable" – and hence more easily visible - how people actually value their socially or commercially available resources. Such consumer opinion publication can build a qualitative "selection pressure" on producers, working to enhance the ultimate quality of their product offerings (Naeve 2005).

Collaborative Adaptive Learning Platforms

These approaches lead to new collaborative and adaptive learning platforms (CALP) which neatly integrate elements from social software use with the need for business oriented learning management systems for professional learning. CALP aims at supporting life-long competence development and represents a fundamental shift toward a more social, personalized, open, dynamic, and distributed model for learning. The main goals of CALP are on the one hand to achieve the highly challenging task of personalized adaptive learning. That is, to place the learner at the center, give her the control over the learning process and if possible deliver quality learning resources that are tailored to the learner's needs, preferences, interests, skills, learning goals, cultural background etc. On the other hand, CALP needs to support collaborative knowledge creation and foster community building. In CALP a strong emphasis has to be placed on personalization and collaborative work as the cornerstones of the learning process and means to improvement, performance and effectiveness. The primary challenge of CALP is to support life-long competence development by providing means to connect people to people as well as people to the right knowledge. Evolving Web 2.0 concepts and social software technologies have the potential to achieve this challenge and overcome many of the limitations of traditional learning models. CALP has to be based on these concepts and technologies and need to encompass the following elements:

(a) Support for personal knowledge management (PKM). Blogs are great tools for personal knowledge management. They help people organizing and exchanging their personal knowledge and the knowledge they have acquired. In the corporate context, personal business blogs helps the dissemination of knowledge through the organization and offer a platform where knowledge can be shared among employees by reading each other blogs, giving feedback and linking to other entries found in a colleague's blog or elsewhere in other learning communities.
(b) Support for collaborative knowledge capturing, sharing, networking, and community building. Group blogs and wikis for example are effective collaborative knowledge capture systems that support learning communities in

designing, creating, reviewing, commenting, modifying, and posting learning objects as support for real time collaboration and authentic learning experiences. In the corporate context, group business blogs offer an opportunity to communicate with employees, suppliers, vendors and partners and provide an efficient way to reach out to customers. Corporate wikis are also a means to connect to other people, share knowledge and form learning communities. Furthermore, webfeeds and pod/vodcasts can be used as a communication medium between employees, partners and customers.

(c) Support for both top-down and bottom-up annotation schemes. The top-down scheme is basically based on system-driven standard-compliant automatic metadata generation to enable indexing, storage, search, and retrieval of appropriate learning assets and learning paths relevant for a specific learner or a group of similar learners. The bottom-up scheme enables personal and collaborative annotation/tagging of learning resources and fosters community building as users share, organize, discover, look for what others have tagged and find people with same interests. Social tagging/bookmarking and folksonomies are good examples of bottom-up annotation systems. Personal mark-up annotation also falls under this category. It allows the learner to annotate the content much the way she would annotate on a paper. The annotations can be circles, lines, underlines, highlighting of text, as well as writing freehand in the margins.

(d) Support for distributed opinion publication networks - and other types of networks – based on Semantic Web technologies. Such networks will be crucial in the community-specific bottom-up organization of tags that will result in community-specific tag-ontologies - built on top of huge folksonomies of tags - for community-specific purposes.

(e) Support for access and search across content and metadata. A learner should be able to query remote distributed learning asset repositories to quickly locate appropriate learning resources. This remote querying facility should be as transparent as possible for the users: queries sent to the own machine are automatically sent to remote repositories and the results are ranked globally and presented back to the user.

(f) Support for personalized learning resource delivery through an intelligent adaptive engine, being able to connect people to the right knowledge and deliver quality learning resources that are tailored to the learner's preferences and learning goals. The adaptation engine handles learner models, gives recommendations, and places the learner at the center by giving her the chance to negotiate the learning experience and to evaluate this experience afterwards.

(g) Support for personal social networks (i.e. individual's self-defined networks) to facilitate bottom-up socialization, that is, help people build new relationships and enable them to join learning communities based on their preferences.

(h) Support for personalized expert/community retrieval. The idea is to connect people to people through content. For example, by searching blog-based distributed communities via metadata and webfeeds and assessing the blogger's digital reputation (i.e. analyzing the feedback, comments and track backs to the blogger's posts), it is possible to identify experts inside or outside the organization with the required know-how that can help achieving better results or persons who share the same interests.

(i) Support for evaluation by quantifying and qualifying user experiences by joining HCI, social capital theory (Granovetter 1973), social exchange theory and Actor-Network Theory (Latour 1998).

(j) Social-topic networks: support for newcomers to integrate in a company. New employees are able to visualize the social networks existing inside the company, immediately find the most representative person for a certain topic and access the most important resources with respect to a certain subject.

(k) Support for a distributed architecture. Service or Web Oriented Architecture (SOA & WOA) and Web Services over protocols and specifications like WSDL, XML-RPC and SOAP (Gottschalk & Graham 2002) or lightweight approaches like RSS, XML/HTTP, and REST enable new forms of social software applications. The accessed microcontent can be remixed and multiple modular Web applications dynamically assembled to create mashups (Chatti et al. 2006b).

Conclusions and Outlook

The PROLEARN network of excellence (Wolpers & Grohmann 2005) as well as the other EU financed projects which have created the Professional Learning Cluster PRO-LC (http://www.professional-learning-cluster.org) have recognised the importance of social software for professional learning. We have tried to illustrate our motivation and give some theoretical background. From our experiences in previous and ongoing projects, we are motivated to identify some systematic solutions for professional learning at the workplace. We have sketched some key

requirements for collaborative adaptive learning platforms. Evaluating such platforms by providing companies and people tools for self-monitoring their behaviour in social networks is a great challenge. In the PROLEARN network, we are committed to tackling this issue. We are organising a series of events around the topic of social software for professional learners, aiming to bring together social software researchers and practitioners in an open space for in-depth conversations about their work, possible trends, and visions. The topics covered include business perspectives such as the potential of software tools for knowledge sharing and professional learning.

Two major critical success factors for life-long learning social software are high usability and good sociability, with each of them comprising a set of criteria and measures (Preece 2001).There are inherent social-technical gaps that seem unbridgeable (Ackerman 2000; Olson & Olson 2000), especially the issue of trust that is intricately related to privacy and security. Some standardization efforts and initiatives have been undertaken (Law & Hvannberg 2007) to address this tricky problem, but their actual impacts are yet to identify. There exist no standard ways to measure the above attributes, making benchmarking studies especially difficult, if not impossible. Evaluation of social software is very demanding, given the high variability in users, tasks and contexts. The extended period of interaction among multiple and dynamic user groups may render the conventional, general evaluation methods inadequate. We deploy cross-media dynamic social network tools (Klamma et al., 2006) within the framework of Actor-Network Theory (Latour 1999) for monitoring and self-monitoring purposes of the affected communities. Digital social networks change the agency of people by the visibility of 'things', how they are created and managed and framed in discourses. The 'cow paths' in social software are results of unintended collective action. Put together the underlying research question here is: How to quantify and qualify learner experiences in deploying social software?

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