Language Technologies for Lifelong Learning

LTfLL -2008-212578

Project Deliverable Report

LTfLL consortium's approach to integration – Additional report

Date of delivery	**Contractual**: 00-00-0000 **Actual**: 01-10-2010
Code name	**Version**: 0.0 Draft ☐ Final **X**
Type of deliverable	Report
Security (distribution level)	Public
Contributors	OUNL, UNI-MAN, PUB-NCIT, WUW, OU-UK, BIT-MEDIA, UPMF, UU, UTU, IPP-BAS, AURUS-KTS
Authors (Partner)	LTfLL Consortium
Contact Person	Wolfgang Greller
EC Project Officer	Ms. M. Csap
Abstract (for dissemination)	This report describes the LTfLL approach to integrate the support and advice services developed in the project. The approach comprises theoretical, methodological, technological, and dissemination and validation perspectives. The theoretical layer, based on a common theoretical framework, elaborates on how the services can support learners in both collaborative and individual knowledge building processes. The methodological layer argues the services can be combined in different ways to support learners and tutors in different educational settings, but that stakeholders' needs should be taken into account. The layer exemplifies this presenting an integrated scenario that illustrates how the LTfLL services can support learners in an institutional context. Afterwards, the technical layer describes how the LTfLL services could be integrated into an existing community-based learning management system to provide learners with a personal learning environment. The validation and dissemination layer discusses the additional strategies needed for the integrated approach. Finally, the report presents conclusions and outlines future work.
Keywords List	Language Technology, Language technology tools, Scenario-Based Design (SBD), Knowledge building, Personal Learning Environment

LTfLL Project Coordination at: Open University of the Netherlands
Valkenburgerweg 177, 6419 AT Heerlen, The Netherlands
Tel: +31 45 5762901 – Fax: +31 45 5762800

LTfLL Integration Report: First Steps

Executive Summary

This report describes the approach taken towards an integrated view on the LTfLL project. First, it elaborates on the original scope and assumptions of the LTfLL project and acknowledges the limitations of the approach. Then it presents the integrated view by focusing on four interrelated layers: theoretical, methodological, technical, and validation and dissemination. Subsequently, the report elaborates on each layer in separate sections. Section 2 explains the project's common theoretical framework. This framework explores the vision that the LTfLL services could support learners in both collaborative and individual knowledge building (Stahl, 2006). Section 3 focuses particularly on describing an integrated scenario that explores the way the services would work together in a formal educational context to support learning processes. Section 4 describes how the LTfLL services could work technically together using a mash-up approach that creates a customisable personal learning environment. Section 5 presents the validation and dissemination layer, which discusses the strategy needed to identify the best methods for integration of the services, and how dissemination will be used to create awareness across stakeholder groups. Finally, Section 6 discusses the strengths of the approach and outlines how we would like to move forward with the project.

1. Introduction

The Language Technologies for Lifelong Learning (LTfLL) project was devised to deal with practical problems in supporting the activities of learners and tutors in educational and organizational settings (i.e., work overload and time management issues) through:

- Assessment of student contributions: in particular, giving formative feedback.
- Monitoring of study progress: ranging from dropout prevention to providing personalised advice.
- Community and group support: selecting and creating groups, ordering and archiving threads, providing overviews of the activities of a community as a whole and of the individual actors.

In the project we offer language technology solutions for these problems. At the moment we are in the process of developing six services, which offer independent solutions to these practical problems. In their design there is no premature commitment to a particular theory. We also developed independent scenarios to validate and disseminate the services.

We have now reached the stage where we can assess whether these services can provide an integrated solution to the problems mentioned above. In this report, we describe the approach we are taking towards this integrated view of the project. We address integration through four interrelated perspectives or layers: theoretical, methodological, technical, and validation and dissemination:

1. **Common theoretical background**: We have concluded that the theoretical framework for computer support for collaborative knowledge building presented by Stahl (2006) can effectively unify the different theoretical positions of the services (see Year 1 deliverables). **Section 2** of this report describes the theoretical framework and how the LTfLL services can be positioned in the knowledge building process of this framework.
2. **Common methodological approach - Integrated scenario**: On the basis of the theoretical assumptions described in layer 1 we have developed an example of how the services could be integrated in a formal education context, which is included in **Section 3.**
3. **Common technical approach**: The technical integration of services has been explored using a mash-up approach that creates a customisable Personal Learning Environment (PLE). This approach considers that services are independent from each other but, nevertheless, can share data and services (i.e., 'middleware' software) with other LTfLL services. **Section 4** further describes this technical approach.
4. **Validation and dissemination:** Round 2 will continue as defined in the existing validation scenarios (see D7.2 & D3.2). In round 3, validation will be based on the integrated scenario described in section 3. We will identify combinations of at least two services for specific learning contexts. We will validate both the services and the scenarios with the relevant stakeholders. **Section 5** describes the validation and dissemination strategy for the LTfLL integrated view.

Before explaining the integration approach in detail, we first discuss its intrinsic **limitations**:

- We acknowledge that learners might have different formats to represent their knowledge and there is also a much bigger reservoir of tacit knowledge that might not be expressed in writing. However, in our approach we decided to focus on textual material due to the use of language technologies.

- The LTfLL services are not necessarily envisioned as tools that will be used without human mediation. Services may have technical and ethical limitations; in those cases their purpose is not to replace a human intervention or be used as separated, isolated tools.

- The project selected two domains to explore the ideas and services to be developed: Medicine and Information Technologies. In modern Medicine, clinical practice depends upon self-directed learning with minimal supervision in a workplace environment and is a clear example of the interaction between the individual learner and Communities of Practice. It is in these situations that the learner and the practitioner acquire expertise in understanding, competencies and skills. Furthermore, Medicine is focused on the client (i.e. the patient) and, in this regard, provides a good model for other domains e.g. business studies. Similarly, in Information Technologies, learning occurs in addition to the formal settings in Communities of Practice. In both fields, learning is lifelong and may lead to certification. The description of the work does not state that the project outcomes will apply only to these two domains; however, application to other domains requires further investigation.

- Cultural and linguistic backgrounds play an important role while comparing textual input, even when using English as a lingua franca. The same word can have different meanings for different learners. This inherent feature of human communication can lead to misunderstanding and ambiguity, however, the approach taken by the project whereby lexicalised ontologies or LSA is used should mitigate this problem.

2. Theoretical Layer

In this section we provide a summary overview of the different theoretical approaches, which have influenced the development of the services within LTfLL. We acknowledge that there are distinct theoretical perspectives to observe and influence educational phenomena in practice, and that they are used in different contexts as instruments to make sense of and shape learning environments. Taking the range of theories that have influenced our thinking and the development of the LTfLL services into account, we have evaluated the different theoretical perspectives and have synthesized and presented them in a common theoretical framework: Stahl's knowledge building cycle (Stahl, 2006). The LTfLL theoretical approaches considered in the design of the service can be integrated in this framework.

LTfLL learning contexts and practical problems

In both formal and informal learning situations there are recurring practical problems. Across these learning situations, uniform roles can be observed. A clear distinction can be made between a 'learner' and a 'support' (tutor, guide, monitor) role. In many learning contexts these roles have been assigned to different people, leading to the commonly accepted notions of 'student' and 'teacher'. In practice, both roles can even be taken up by the same person. For example, a self-directed learner in his/her most extreme form (i.e. without any formal support) learns but also bears responsibility for the 'steering and support' of this process. Independent of the practical implementation of the roles, various common learning related problems can be observed linked to the 'learner' and the 'support' role. Research has shown that stakeholders indicate four types of support activities that often lead to work overload (Van Rosmalen et al., 2008), influencing the feedback learners receive and, therefore, affecting the learning process. Some of these activities are (i) assessment of student contributions, (ii) monitoring study progress, and (iii) community and group support.
In the LTfLL project, we aim to solve these practical problems experienced in both informal and formal learning contexts. The support activities identified above take place in different learning environments, which are influenced by distinct learning theories. As is the case with paradigms and theories that come into being to explain social phenomena observed in the world, it is not possible to identify one completely adequate learning theory that can be verified beyond all doubt. There are several ideas and theories that underpin the services developed in LTfLL: language as a basis for mediated learning (Vygotsky, 1978); the two cycles of knowledge building (Stahl, 2006); dialogism (Bakhtin, 1981, 1984); the theory of Communities of Practice (Lave and Wenger, 1991); speech genres (Bakhtin, 1986) and shared knowledge, both formally represented as ontologies (Gruber, 1983) and in the idea of the family resemblances of Lakoff (1987).

The learning sciences consider themselves multi-disciplinary, leaving room for various branches of cognitive approaches as exemplified in Sawyer (2006) and Bransford et al. (2000). However, we can profit from their alternative views on a phenomenon and use them in our solution-seeking process when confronted with a problem in an educational setting. In practice, this would mean that not all learning related problems can be solved by a simply socio-cultural approach, nor by an exclusively behaviourist, repetitive and imitating approach. One needs to look at a specific educational situation and its requirements in order to decide what would be the most suitable approach (Ertmer & Newby, 1993; Jonassen et al., 1993).

Although several of these distinct learning paradigms have influenced the educational circumstances for which the LTfLL services are developed, we argue next that, from a theoretical perspective, the developed services support both a learner's personal and collaborative knowledge building and, consequently, combine both cognitive and socio-cultural approaches. We suggest that these approaches can both co-exist and act in unison within Stahl's knowledge building cycle as a theoretical framework.

The unifying theoretical framework

Stahl (2006), following a social epistemological perspective (Brown & Duguid, 1991; Lave & Wenger, 1991), models the knowledge building process as a mutual construction of the individual and the social knowledge building, striking a balance between the Acquisition (individual) and the Participation (social) Metaphor. In his view, knowledge is a socially mediated product. Individuals develop personal representations and beliefs from their own perspectives, but they also do so on the basis of socio-cultural knowledge building, shared language and external representations. These personal representations and beliefs are extended through social interaction, communication, discussion, clarification and negotiation, which occur in conversations. Learners, therefore, build knowledge collaboratively and then internalise it in a personal knowledge building process. This internalisation also follows Vygotsky's (1978) ideas. As a result, the learners become skilled members of a Community of Practice (Lave and Wenger, 1991), mastering the learning domain speech genre (Bakhtin, 1986). This fact is central in LTfLL due to the project's focus on analysing learners' written materials.

Figure 1 shows Stahl's cycle of knowledge building. The diagram depicts how the personal knowledge cycle and the collaborative knowledge cycle interact. The lower left corner shows the cycle of personal understanding, which can start with a tacit pre-understanding influenced by personal knowing. The right part of the diagram depicts how the social process of interaction with people and with their shared culture influences the individual's understanding. Although personal cognition and social activity are separated in the diagram, it is simply a matter of representation; they can only be separated artificially.

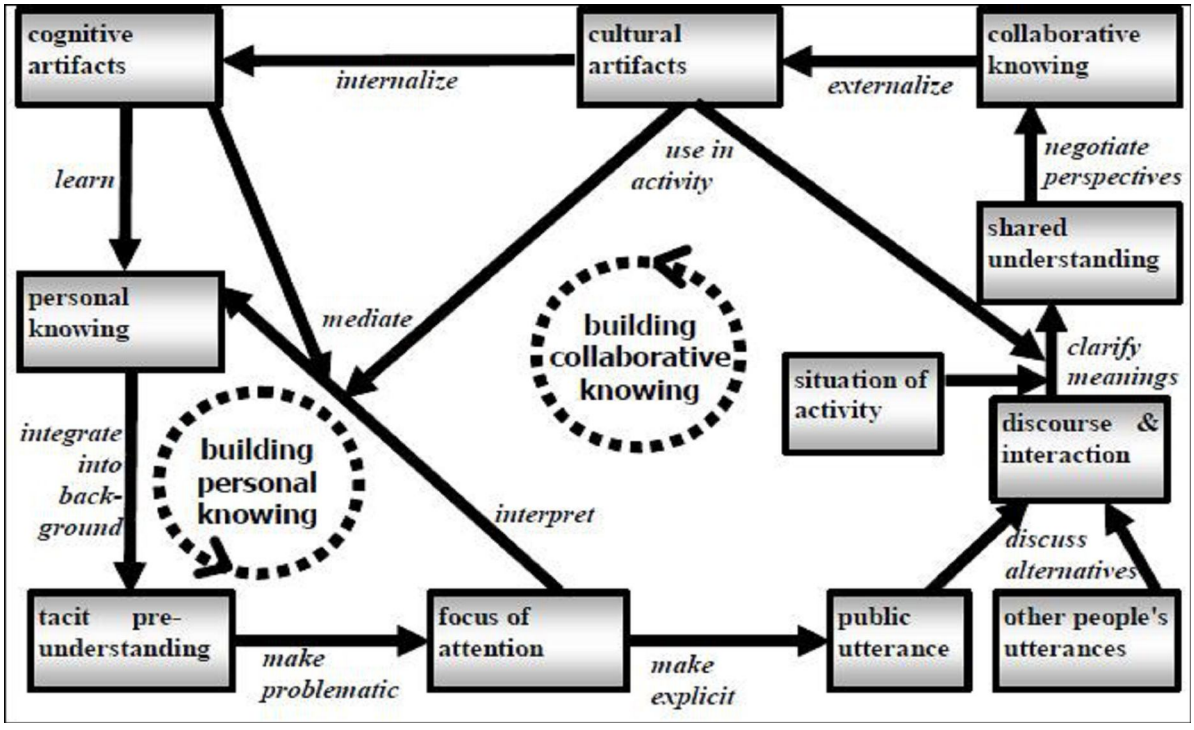

Figure 1. The cycles of knowledge building (Stahl, 2006)

Cycle of personal understanding.
Learning starts on the basis of tacit pre-understanding. This understanding may change if we explicate its implications; by "resolving conflicts or filling in gaps—*by reinterpreting our meaning structures*—to arrive at a new comprehension. This typically involves some feedback from external sources: from our experience with artefacts such as our tools and symbolic representations (Stahl, 2006, p. 196). New comprehension gradually settles in to become our new tacit understanding and to provide the starting point for future understanding and further learning. If we cannot resolve the problematic character of our personal understanding alone, which happens mostly when it is provoked by other people, then we need to enter into an explicitly social process and create new meanings collaboratively. To do this, we typically articulate our initial belief in words and express ourselves in public statements, thus entering into the cycle of social knowledge building.

Cycle of social knowledge building.
In this cycle, an interchange of arguments provides rationales for different points of view which may eventually converge in a shared understanding resulting from a clarification of differences in interpretation and terminology. If the negotiation of the different perspectives does result in acceptance of a common viewpoint, then such a result is accepted as knowledge. In this way, collaboration and undistorted communication mediate between personal belief and accepted knowledge.

The LTfLL services aim to provide feedback support in both knowledge building cycles. In the following section we elaborate further on how they support both personal understanding and social knowledge building.

LTfLL Services supporting personal and collaborative knowledge building

Table 1 gives an overview of how each LTfLL service fits into the Stahl diagram, which processes it supports, what type of feedback it provides and how the learner uses this feedback.

Table 1. Relationship of LTfLL services to the Stahl cycle

4.1. Positioning	
Description	LTfLL-T4.1 aims at developing a service that aids the learner and tutor to discover the learner's position with respect to courses and learning objects in a domain of study. The system works by comparing learner texts (ePortfolios and other generated texts) with model texts, which are representative of the level that the learner is expected to attain. There are two complementary variants of this service: the "knowledge poor" and the "knowledge rich" approaches. The "knowledge poor" approach uses LSA and phrase extraction to compare the texts simply as collections of words, phrases and basic syntactic relations (also providing the learner with feedback on the use of these words and phrases). The "knowledge rich" approach, on the other hand, uses a domain ontology, so that the texts can be compared on the level of concepts
Advantages	*Advantages for the learner* - discover his/her level of expertise so that learning materials/courses appropriate to that level may be provided by tutors, or by a search engine. - become aware of the linguistic differences between his/her text and model texts written by more advanced learners or experts within the community of practice - be able to adapt his/her language use (technical terms, semi-technical terms and common idioms) so that the learner uses a language more typical of members of the community - overcome linguistic barriers to integration into the community of practice, thus promoting more social learning
Personal Knowledge Building	*Comparison of learner text with expert text* - It can also use validated and calibrated course material ("cultural artefact") as a reference point to advise the learner on further learning material/courses that might be useful to them. - The comparisons and course material ("cultural artefacts") can feed back into the personal knowledge building cycle of the learner to be re-interpreted and advance their personal knowing.
Collaborative knowledge building	*Use of course material* - This service compares a learner's textual inputs (their "public utterance") with expert texts ("other people's utterances"). Based on this information the learner receives quantitative and qualitative guidance and feedback. The quantitative feedback shows the learner how far his/her text is linguistically from an experts' text and from this can infer his/her expertise distance. The qualitative feedback additionally provides information as to the phrasal and terminological difference to a text written by an expert. Based on this feedback learners could improve their language use, thus facilitating their integration into the Community of Practice of their domain.
4.2. Conceptual Development	

Description	LTfLL-T4.2 aims to develop a service that helps learners to appreciate their own level of understanding of a particular topic, with respect to how others (colleagues, peers, etc.) or a pre-defined reference model (i.e., learning materials, tutor notes, etc.) conceptualize such a topic. To this end the service analyzes a learner's textual learning evidence (e.g., essays, blogs) and generates a topic representation, which shows the concepts and their relationships from the textual evidence. Afterwards, using a pre-defined list of options, the learner can indicate the type of relationship between the concepts.		
Advantages	*General advantages* - identify the students' understanding of the concepts in a topic. - provide timely and self-directed formative feedback about coverage of a topic at hand; - provides a tool to a tutor to monitor understanding of topics in individuals and groups; - makes the feedback process more consistent and reduces the time required for responding to feedback/assistance requests.	*Specific advantages related to personal understanding of topics by a learner* - improve speed and objectivity of feedback by allowing self-direction in requesting feedback; - provide individual learners with feedback on their relative understanding of a topic related to a reference model and the option to contact a tutor; - provide feedback on the basis of a bridgeable gap between current understanding and required understanding; - provide individual learners with feedback on their relative understanding of a topic with respect to a group of learners; - provide a tool which enables a tutor to be informed of the insufficient progress of a learner.	*Specific advantages related to collective understanding of topics* • initiate discussion/collaboration between group members by providing visualizations of amalgamated concept maps of all learners and comparing it to personal concept maps; • provide a tool which enables a tutor to monitor the collective understanding of a topic of a group of learners for collective progress in understanding (which can, for example, result in adjustments in learning materials analyzed to create the reference model).

Personal Knowledge Building	*Creation of visualization* - Learner provides evidence of her understanding of the topic ("public utterances" in natural language, i.e. learner's text) - A visualization is provided of the learner's public utterance in the form of a concept map of the learner's textual inputs (containing concepts and the relations between those concepts). - Learner is then asked to further indicate the relationships between the concepts as part of the "re-interpreting of meaning structures". - Visualization itself can be used as an artefact for reinterpretation and building of personal knowledge. - *Comparison of visualizations to reference model* - Comparison with a reference model identifies gaps that represent the problematic areas in the understanding of a topic and form the focus of attention. - Individual feedback is received through suggested readings to further develop understanding, to close the gaps between the reference model and the personal map. - Repeated submissions of texts to our service allows for closing the "building personal knowing" cycle
Collaborative knowledge building	*Comparison of visualizations to emergent group model* • The textual input of several learners can be processed into individual visualizations. • From these concept maps, an 'emergent group model' is amalgamated that visualizes the joint textual inputs learners have submitted to the service. • The emergent group model provides discussion points and through collaboration it can lead to shared understanding • Ultimately, the emergent group model can provide a 'cultural artefact' of the joint understanding of the group (at that moment in time) that closes the 'building collaborative knowledge' cycle. • The emergent group model (as a cultural artefact) then again provides input for building personal knowing.
5.1. Recommendations based on interaction analysis	
Description	LTfLL-T5.1 has two goals: giving support and feedback for students who learn collaboratively using chat conversations and discussion forums; assessing and abstracting these collaborative activities that the tutor can then use for grading or supporting the student.

Advantages	*General advantages (valid for both chats and forums)* • provide feedback to students about their coverage of the domain and the quality of their collaboration; • provide an assessment tool for the tutor and teacher; • make the grading process more consistent and reduce the time required for grading by automatically assigning a grade to each participant; • identify the students' understanding of the topics/concepts that relate to the curriculum.	*Specific advantages related to discussion forums* • provide feedback to the tutors who act as moderators (if there are any); • discover the most important peers with regard to specific concepts from the domain of knowledge; • discover the most important messages in a thread of discussion on a specific concept or topic.	*Specific advantages related to chat* • improve the level of on-topic collaboration between the participants of computer-supported collaborative learning (CSCL) chats by studying the transfer of knowledge in the group • provide a tool for visualization of CSCL conversations and identifies the most important parts (with respect to collaboration).
Personal Knowledge Building	*Feedback on domain coverage* • Learner's participation in chats and forums also provides cues on domain coverage by the learner. • The learner also receives feedback about domain coverage in chats and forums. This can challenge the tacit pre-understanding of a learner and, as a result, make problematic some issues that should be collaboratively discussed in further chats and forums. This feeds back into the personal knowledge building cycle		

<table>
<tr><td>Collaborative knowledge building</td><td colspan="3">Feedback on discourse and interaction

• This service supports a constructivist approach to learning (knowledge being constructed through social interaction).
• With discourse and interaction analysis, learner's participation in chat and forums can be analyzed to extract cues and feedback to improve social interaction.
• This service works well in terms of providing cues and feedback to improve the social activities from the right part of the diagram (make explicit, discuss alternatives, clarify meanings, negotiate perspectives).</td></tr>
<tr><td colspan="4">5.2. Recommendations based on assessing textual products</td></tr>
<tr><td>Description</td><td colspan="3">LTfLL-T5.2 is aimed at assessing and giving automated feedback for students' written activities such as free texts production (e.g. essays, syntheses) in a distance-learning context. It dynamically gives them access to texts matched to their level of understanding/questioning.</td></tr>
<tr><td>Advantages</td><td>General advantages for students

• help to obtain texts to read which match their level of understanding/questioning of the course;
• help assess some features of the read texts (e.g. their most important parts);
• help formulate questions about course aims and how to find out answers;
• help write summaries/syntheses of the read texts in order to prove they have understood the course;
• provide good quality feedback on that summary (cohesion between sentences, coverage of concepts, misconceptions etc.) in good time.</td><td>General problems for teachers

• enable students' understanding of their course by means of course reading and summarization
• give students personalized comments and direct them to investigate important notions;
• get an overview on the way the individual student understands the course texts to enable timely adjustments to the course;</td><td>General problems for tutors

• provide methodological and organizational support to students' learning process;
• give feedback on process and (intermediate) results during the instructional activities.</td></tr>
</table>

Personal Knowledge Building	*Support for individual learning activities (reading, writing, questioning)* • Students can use their personal knowing to type keywords in order to retrieve texts to read. • Then, by reading the retrieved texts (which are cultural artefacts), they can understand the content and focus their attention where it is needed. • By writing summaries and asking questions, their personal knowledge can be refined through the feedback received from the service. This service engages students into a three-way process: reading texts, writing summaries/syntheses and getting feedback from the first two activities.
Collaborative knowledge building	• students can share reading advice with each other; • after writing their summary, students can compare their feedback with each other and discuss its relevance and ways to improve the quality of the summary.
6.1. Creation of a Knowledge Learning Network - Formal Learning Support System	
Description	LTfLL-T6.1 (Formal Learning Support System (FLSS)) is built on the Common Semantic Framework (CSF). This CSF supports formal and informal learning. The focus in this service is on supporting formal learning tasks. FLSS facilitates: (1) storage and manipulation of annotated learning objects; (2) direct communication among learners and learning content, and indirect communication among learners; (3) support for search; (4) ontology management; (5) user friendly visualization.
Advantages	*General advantages for students* • find information in a certain domain by providing a corpus of learning materials (with less noise) • compare their knowledge to the knowledge of others by means of a pre-defined ontology (= a partial conceptualization) in a particular domain • extract semantically related knowledge from learning objects • can manipulate the existing learning data (uploading, processing, adding metadata, searching, navigating) • compare their own intuitions to others' opinions on a certain topic/learning material
Personal Knowledge Building	*Finding cultural artefacts* This service supports personal knowing by finding cognitive cultural artefacts within the service, such as: o a corpus of semantically annotated learning materials in a particular domain o a domain ontology, which provides the formal conceptualisation of the domain o facilities, such as: search, editing, and visualisation of the learning material
Collaborative knowledge building	*Annotating cultural artefacts* - This service allows the learner to comment on learning objects and stores these comments and changed materials in its space. - In this way, the learner can access their peers' opinions on a particular material or topic for further information and clarification of their understanding. - The learner can also leave his/her own comments and can produce materials for others. This service therefore supports the externalizing process through public utterances and creates the grounds for engaging in discourse and interacting with other people, opening up the possibility for shared understanding.
6.2. Adding a social component to public knowledge	
Description	In LTfLL-T6.2, an informal learning component is developed based on social media

	applications and social networks. This service has two goals: to complement the formal knowledge represented by ontologies with the informal knowledge emerging from social tagging, and to connect learners to one another. To this end, the content the learner is searching and selecting will be used as a trigger to get them in touch with other users who have tagged or used this content before them.
Advantages	*General advantages for learner* - recommend relevant material related to the learning task - allow learners to connect to other people who can function as learning mates/tutors
Personal Knowledge Building	*Finding cultural artefacts* - The service identifies other learners through the learning objects (cultural artefacts) they tag. - The objects that are suggested by the service again feedback into the personal knowing cycle of the learner, as they can be reinterpreted into personal knowing
Collaborative knowledge building	*Identification of peers* - This service supports the learner in identifying, engaging in dialogue and interacting with relevant peers who can input their visions on a topic/field (other people's utterances). - The service identifies other learners through the learning objects (cultural artefacts) they tag. - As experts have a larger influence in this process than normal users, the social dynamics of the service support the localisation of suitable tutors to help other users. This is slightly different to the Stahl diagram, in which no distinction is made with respect to the level of knowledge of the different users.

3. Methodological Layer

This section presents the result of using the Scenario-Based Design (SBD) methodology to jointly produce an integrated scenario rooted in stakeholder needs. Our starting point was to analyse the stakeholder needs expressed in the six solution scenarios for WPs 4-6, and to extract the objectives (business value) of the proposed LTfLL services from the scenarios (see D3.2). This unique business value of each service was expressed in a concept called 'Unit of functional value' (see D7.2), which is at the core of each service. In an independent exercise, we asked partners to identify the synergies between their own and other WP tasks. We developed the integrated scenario based on these analyses.

Integrated scenario

The services can in principle be combined in several ways in order to support work processes in different educational settings. We have defined below an extensive integrated scenario for

institutional settings, but the services can also be used jointly in order to support learners and supporters in informal settings. A scenario that describes how a lifelong learner could use the services in an informal learning setting is presented in Annex 1. An important consideration in developing the integrated scenario for the institutional setting was that we can validate the scenario with real stakeholders associated with the project. We therefore propose an integrated scenario in the IT domain.

The following scenario is written from a practitioner viewpoint. This scenario is viewed in the project as a means of communication with stakeholders, rather than as a technical description.

Maria Smith – a lifelong learner

Maria has been working as a programmer/analyst for several years for a large company. She joined the company when she was 16 and has steadily developed her skills. She has enjoyed her work and was saddened when her company made her redundant owing to the recession. Maria is pleased to have obtained a good redundancy payment. She decides to use this opportunity to become an IT teacher. She draws up a plan to get there. She decides to work part-time while following one or more part-time degree courses at her local college to achieve a formal qualification in some of the newest trends on IT, such as Web 2.0 technologies and Software Project Management.

As she does not have any degree yet, she realises that she might be able to apply by means of an Accreditation of Prior Learning route (APL). This would allow her to get acknowledgement and accreditation of the knowledge she already has around Web 2.0 and Software Project Management.

The college offers such an APL route by means of an admission and accreditation panel, which requires Maria to submit her CV with previous work experience, to answer content related questions and to submit the relevant job description for the type of work she would like to target (i.e., IT teacher). The college uses the LTfLL-WP4.1 service, which compares the information Maria provides with the prerequisite knowledge and skills for each module for the two courses Maria is considering. From examining the outputs of LTfLL-WP4.1 service, in conjunction with the conversation Maria had with the admission and accreditation panel, it turns out that the two courses Maria has already identified as relevant are indeed useful in her journey to become an IT teacher. Supported by the LTfLL-WP4.1 service, the admission panel decides that Maria also has almost sufficient knowledge in the domain of Web 2.0 technologies, and that she only needs to participate in a small collaborative group discussing some topics in order to update her knowledge. When she has sufficiently studied this topic (which will be assessed by a teacher who is supported in his judgement by the 4.1 service analysis of her contributions in the CoP), she can then be accredited by the panel for the full course on Web 2.0 technologies. To learn more about the Software Project Management, the panel informs Maria that indeed she needs to update her competences. The best option is to follow the course 'Software Project Management', led by Professor Dan Jones, with the support of Dr. Emma Zeppin.

*****

Dan Jones is a teacher in the IT faculty of the local college. Last month he revised a course of 'Software Project Management' that has been running for five years. Dan's objective was to provide

a higher quality learning environment with existing resources (tutors, facilities etc). He also sees that if he can provide personalized feedback, it will help students with their progress and he expects that students will be more satisfied. However, he does not want to increase the number of tutor contact hours; in fact, he wants to lessen the burden on tutors' precious time so they are able to devote more time to students needing attention. He thinks of a solution in the direction of a course re-design which changes the way students and tutors participate in the learning process. He will introduce a new pedagogical approach, assisted by a set of new services for supporting students as well as tutors which the college has just installed –the 'LTfLL services'.

From the LTfLL services, Prof. Jones can use one of them (LTfLL-WP6.1) to find newer course materials by searching in the college's electronic library, alongside annotations from other teachers on how to use the materials. As he is a member of the Community of Practice (CoP), he also checks their social networking site (LTfLL-WP6.2). From these resources he can compile his course materials and creates an entry in the learning environment of the course.

Next, he instructs his tutors to set up support, which consists of several new services: a service to visually compare the official course materials (reference models) with student writings on a certain topic (LTfLL-WP4.2), a service to receive feedback on the correctness and completeness of student writings (LTfLL-WP5.2) and a service that analyses chat and forum messages (LTfLL-WP5.1). As his college also has a policy of retaining contact with alumni, he also aims to introduce his students into the Community of Practice and his social network, which serve as a links between the faculty and the professional world his students will enter after graduation. There is also a service (LTfLL-WP6.2), which is based on social web applications and social networks, that can help learners and tutors search for information about the topic, as well as relevant people to whom they could address questions.

He also likes being able to monitor the development of cohorts of students remotely and at various points through the course, using the LTfLL-WP4.2 and WP5.1 services. Where he sees a significant difference between cohorts, he is able to investigate the underlying reasons and talk to tutors where he thinks they may be experiencing difficulties. Using the LTfLL-WP4.2 service, he also sees the topics that are generally not covered well which enables him to discuss these at tutor meetings in order to improve teaching/facilitation in these areas.

*****

Emma Zeppin, one of the tutors of Dan Jones' courses, creates topic spaces (LTfLL-WP4.2) from the new course materials the teacher gave her, with the help of one of the new LTfLL services. She will later make these topic spaces available to student, as part of the course's learning environment. The service helps her to analyze the materials to create a model showing the concepts used in the topic, to add reading suggestions to the concepts and to create meaningful links between the concepts. Later on, when students start using the service, she needs to check it regularly to see if students need support and if there are any structural problems in understanding the course materials. She reports this back to the teacher so that he can perhaps adjust the learning materials.

She is also responsible for setting up and maintaining a bank of topic spaces, or reference models, on different topics. To do this, she collaborates with other professors and tutors in other institutions, with whom she could get in contact using the LTfLL-WP6.2 service.

Emma feeds the learning materials into the student writing support service (LTfLL-WP5.2) and also the chat and forum analysis service (LTfLL-WP5.1) as reference material, which gives her feedback on how students are contributing and if they are contributing equally. This allows her to provide grading suggestions to the teacher later on. Finally, she sets up the new students' accounts in the learning environment the institution provides and maintains.

Emma checks reports submitted through the essay service. She checks the reference topic model provided by a supporter with the joint student topic model for discrepancies. She also checks the feedback from the chat and forum service for signs of inequalities in the quality of the students' contributions. She then provides the teacher with a grading suggestion.

Emma is also responsible for structuring the learning environment. She uses the LTfLL-WP6.1 service to select a bank of learning objects that she makes available through the student portal, and she uses the LTfLL-WP6.2 service to identify texts suitable for students to use in the LTfLL-WP5.2 service, as well as to provide extra literature reading suggestions, which are linked to the topic reference models (LTfLL-WP4.2 and WP6.1 services).

*****

Maria enters the new course on Software Project Management. As a first group task, her group needs to develop an understanding of what a software project is all about. This is not an easy task for newcomers, but it will provide them with an impression of the complexities of the course topic. They discuss the task in the chat service of learning environment (LTfLL-WP5.1). As a special feature of the chat service, they receive feedback on whether they have covered the whole task in their discussion. It is agreed that she will further focus on methodologies for software engineering, whereas other group members will focus on other topics. From the materials she picks up from the learning environment, she starts writing an overview of her topic. She first submits the document she has written for textual feedback on its completeness and coherence to the essay service (LTfLL-WP5.2). She receives suggestions on some parts that may need to be rewritten but she knows this is not the only feedback service she can submit her materials to. She also submits the overview she has written to the topic space of LTfLL-WP4.2. She can now visually compare the analysis of her writings to the analysis of the official materials, which shows she still lacks coverage on some concepts. The other students in her group also submit their materials. Taken together as their group product, the visualization should match the model derived from the course materials but upon looking at the joint results from all students, she notices that she missed out on important parts. The feedback she receives by mapping her reference model and the group reference model to the course reference model gives her a good basis for further discussing progress and next steps with her group members.

To support exchange of ideas within the CoP of the college, the learning environment provides a chat and forum service in which she starts a discussion on their difficulties with completing the task. Soon other students join in. The chat and forum service (LTfLL-WP5.1) that analyses their contributions keeps track of both synchronous and asynchronous discussions. As alumni also have access to the community, they sometimes chime in with remarks. While the language use of both students and professionals is compared by service LTfLL-WP4.1, students can also get feedback on concepts that are used in the field and on how well their assimilation into the body of professionals is proceeding. Maybe others who are more knowledgeable participate in this CoP and try to put the topics they discuss in a wider perspective, providing suggestions for questions in their social network. This provides Maria and the other students with new contacts and new materials to look in to. These contacts can also come in hand when they become professionals themselves.

Using these sources and newly acquired angles to look at her subject, Maria rewrites her part of the overview on Software Project Management methods and resubmits it to start a new cycle of textual analysis. There are still some discrepancies between the official materials and her submission, so she asks her tutor to look into them and provide her with some recommendations and further activities to fill the gaps.

*****

The integrated scenario will function in the rest of the project as a context to explore further technical integration of the services as well as a framework for further validation activities.

4. Technical Layer

This section shows how the different services developed by project partners technically work together and how they can be integrated by mashing-up the different modules into an existing community-based learning management system, thereby creating a customizable personal learning environment.

Integrated Technical Vision

A recent trend in education and in web development is to build learning environments on top of web platforms which are carefully designed to host a plurality of software components (widgets/plug-ins) which can be organized or combined (mashed-up) at the user's convenience to create personalized environments. There are a wide array of web platforms exhibiting different functionalities but all build on the same concept of aggregating components together to support different tasks and scenarios (Palmér et al., 2009).

As in the LTfLL project the partners are developing different kinds of software artefacts with the help of multiple and varying technologies, the integration approach chosen must allow for combining these artefacts with a high degree of individual freedom in software system design choices. Consequently, the consortium has chosen the mash-up Personal Learning Environment approach (MUPPLE, see Mödritscher & Wild, 2008) as the integration strategy. This allows the project partners to develop software in their own context and plug-in these loosely-coupled software artefacts in an integrative environment, thus generating a set of customizable services. On the one hand, the advantage of this approach from the learner's point of view is that heterogeneous software systems are plugged into a single environment: they can be arranged individually but can feel and look like one coherent software system. On the other hand, benefits for the software developer and system administrator are – beside those already mentioned above – that a modularized system like this can easily be plugged into different platforms with less effort, making it highly interoperable and re-usable. Providing services with standardized interfaces brings the question of an integration strategy to a higher level, eclipsing technological decisions on programming languages or database management systems.

To get an overview of the whole cycle of services supporting the learner, they are displayed along the line of the WP tasks in Figure 2. Technically, the learning environment is centrally integrating the services through widgets. By using the services, an evidence collection is built-up of digital traces left whilst learning (technically realised as distributed data storage).

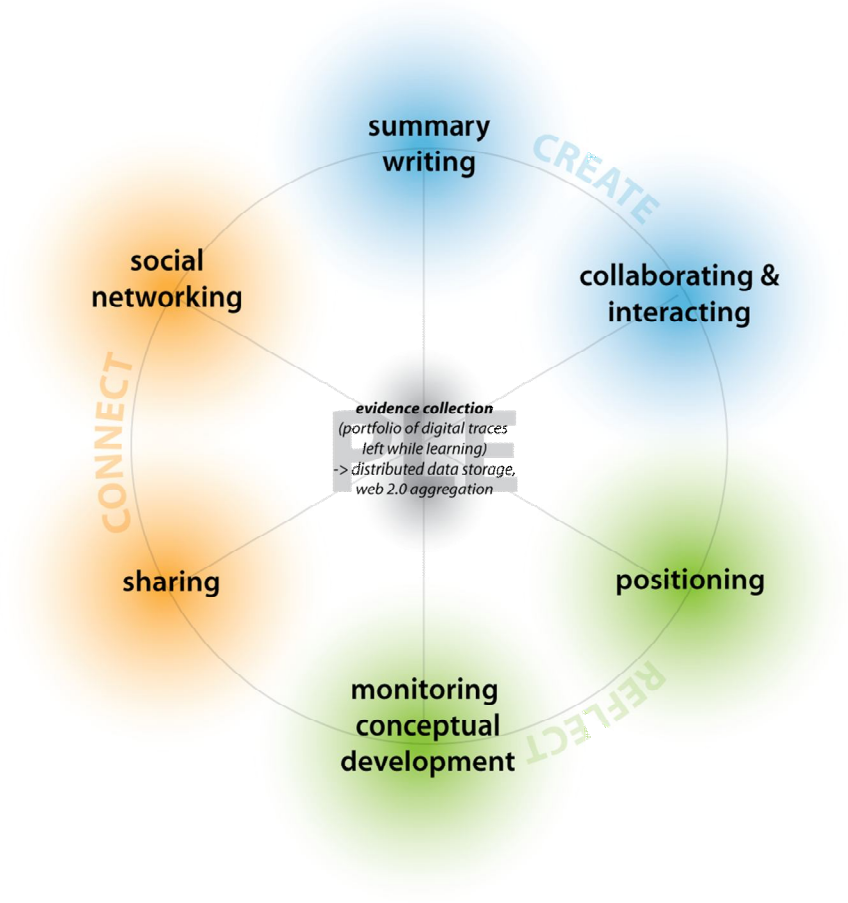

Figure. 2: Big picture: supporting services from WP tasks.

Below we will focus on the actual technical integration using web-services mashed-up in a Personal Learning Environment (PLE) using widgets. Furthermore, interconnections between the individual services are described as well as possibilities of sharing data along a technical and educational workflow, illustrating service interactions in a scenario-based example. Privacy issues, scalability of the services, platform design choices as well as trade-offs of the technical solution will also be discussed.

Architectural View on Web-based Service Approach

Architectural decisions have been made in deliverables D2.1 and D2.2 describing a service-oriented approach as a three-tier layer system. As details can be found in these deliverables we will not explain the service architecture here in full depth. A very simplified but illustrative example of this approach to integrating services into an existing platform can be seen in Figure 3. A widget is plugged into an existing Personal Learning Environment (PLE), where learners can use it. This widget container uses two web-services (A and B) for generating results, which are then displayed to the learner by the widget. Service A fetches data from a database and from another service, Service C,

and delivers its results to the widget. Service B fetches data from an external source, giving back data to the widget where the results of both services A and B are rendered visible for the learner.

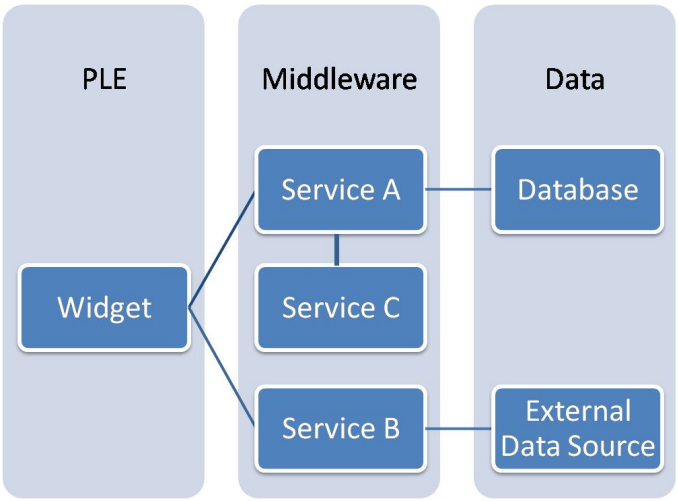

Figure 3: Illustrative example of proposed integrative service approach.

This simplified example can be extended: more than one widget can be integrated in a chosen platform, communication methods and messages can be standardized, and web-service interfaces have to be defined as well as made public, for example through a directory service (specified through, e.g. WSDL). One advantage is immediately apparent when looking at Figure 3: all layers are loosely coupled, which means they are connected over a network and modularized in their own working scope. Widget integration in existing platforms is state-of-the-art in achieving Personal Learning Environments. With the architectural design we have taken into account the spatial distribution of contributing partners in the project. Software artefacts are not seen as static and stand-alone programs, but as interactive services offering specific problem solving mechanisms to other services. Different technological applications can therefore interact and build on top of other developed services – thereby gaining greater power.

The consortium believes that this design will be the best for the LTfLL services, as they will be added as a surplus to existing learning systems and to the learner by solving practical problems in learning support activities using language technologies.

Technological Development Strategy

As described in the previous paragraph, a loosely-coupled widget-based integration of web-services is targeted. Certain technological decisions obviously follow: for example the front-end presented to the learner should be rendered via a web-browser and the communication between the different layers should be done over HTTP. A survey gathering the different technologies used by all developing partners can be seen in Annex 2. From this data, technological design decisions are made which allows for all partners to be able to provide their software artefacts as web-services. Therefore, the following paragraph describes and specifies technologies, which are used throughout

the whole consortium to pave the way for the exploitation of synergies between the services across the project.

Personal Learning Environment

Designing widgets viewable in a web-browser is ideally done with pure client-side run-able components, like HTML, CSS, and AJAX (but Flash or other technologies for designing rich internet applications are no problem at all). Widgets are integrated into PLEs by using a container, ensuring the ability to plug in and to communicate between widgets. Style sheet definitions (CSS) offer possibilities to configure the widgets to expose a common look and feel. Web-services are called over standardized network protocols (HTTP) with distributed software architectures (RESTful services). Data exchange between provided web-services is done using structured message formats like XML. As different services from all WPs are turning public in this period, we are in the process of extracting the web-service interfaces and making them accessible to the rest of the consortium to guarantee interoperability. Therefore, documentation explaining the interfaces will be written and internally distributed. This will help in building a handbook to guide partners calling applications from others.

For integrating the different services and to test their interaction possibilities, it is necessary to have a PLE platform for showcasing the developed software artefacts. The decision was made to use Elgg (Elgg, 2009) along with the widget container engine Wookie (Wookie, 2009).

Wookie was chosen for several reasons: it is standard compliant with the W3C widgets 1.0 specification, has a large educational community, was developed by former EU project TenCompetence, is open-source, is an Apache Incubator project, and has plug-ins available for different learning environments like Wordpress, Moodle, and Elgg.

The platform decision is not a particularly critical one as it is very easy to plug the widgets into other platforms at any stage in their development. The decision was made because Elgg was originally developed from an educational context perspective, has a large supporting community, is open-source, and has an existing Wookie plug-in. The choice of Elgg is also supported by other factors. As the focus of this project lies on software development in the field of natural language processing supporting lifelong learners, the underlying platform has to handle user management, access control, community networking and so on. Elgg offers a wide range of modules capable of these issues and is easily extendable.

Along the six dimensions proposed by Palmér et al. (2009), the integrated services need interoperability of data and meta-data across widgets and underlying services. Furthermore, there is a strong social component needed for the ability to define lists of friends, recommendations and the creation of specific learning groups with users of the same interests. Another important feature affecting the screen dimension is the possibility to organize several widgets within a PLE in a spatial manner. This is in accordance with the activity dimension, which supports the educational workflow of a learner by enabling widgets to be displayed and made invisible, thus leading the way of the

learner. However, some care has to be taken in orchestrating how users should use a set of tools and services to achieve a certain learning goal.

Middleware

The distributed architectural decision taken ensures the scalability of the proposed approach. PLE, web services, database(s), and special heavy computational algorithms (like some NLP related tasks) can be distributed on separate physical machines allowing for balance loading and optimal response times. Caution has to be taken regarding computationally very time-intensive NLP services, where optimal algorithm design, caching, and pre-processing methods for data reduction have to take place to ensure ideal efficiency. By having a look, for example, at the LSA based computational algorithm, open-source software (R with tm and lsa packages) was modified to optimize, among others, the production of text matrices to allow them to be stored sparsely.

As can be seen from Annex 2, a variety of software and language technologies are used. With this design approach, it is possible to connect these different applications. We have a customizable system, which can easily be used in a wide range of learning environments. It only has to be assured that one service can take the output from another as its input - this is ensured by the definition of connection standards (here: an XML definition). As there are also overlaps in WPs regarding NLP specific tasks (WP4.1, 4.2, 5.1, and 5.2), they will be managed through a unique NLP pipe offering standardized services (like text pre-processing, stemming, etc.). This is to reduce the workload by minimising double developments and enforcing code reuse.

Service and Data Commonalities

The educational workflow of interconnecting the services is described as an integrated scenario in Section 3. As has been mentioned before, it is technically ensured that the services can talk to each other over defined and publicly available interfaces. That implies the reuse of data because one service can serve as input to another service. Two main data formats for service communication have been identified and are used project-wide: RDF and RSS. Displaying data in one of these two formats is standardising the input structure for services.

Concretely, data is reused extensively throughout the tasks for supporting the learner through positioning, conceptual development, writing summaries and collaboration and interaction services. Corpora are made public, centrally stored, and – as there are interfaces for pre-processing and generating spaces – centrally managed. Along the line NLP-based processing services are shared by different partners. Furthermore, services covering sharing resources in a social network are using software and data commonalities.

Abstracting Figure 2 from their WP dependencies (resulting in Figure 4), on a technical level, service artefacts are discovered which communicate RESTfully in a structure on a level, which ensures that data and functionality reuse is possible. In the next paragraph the integrated scenario is

incorporated in an educational workflow on a technical level and treated as a use case to find data and service commonalities.

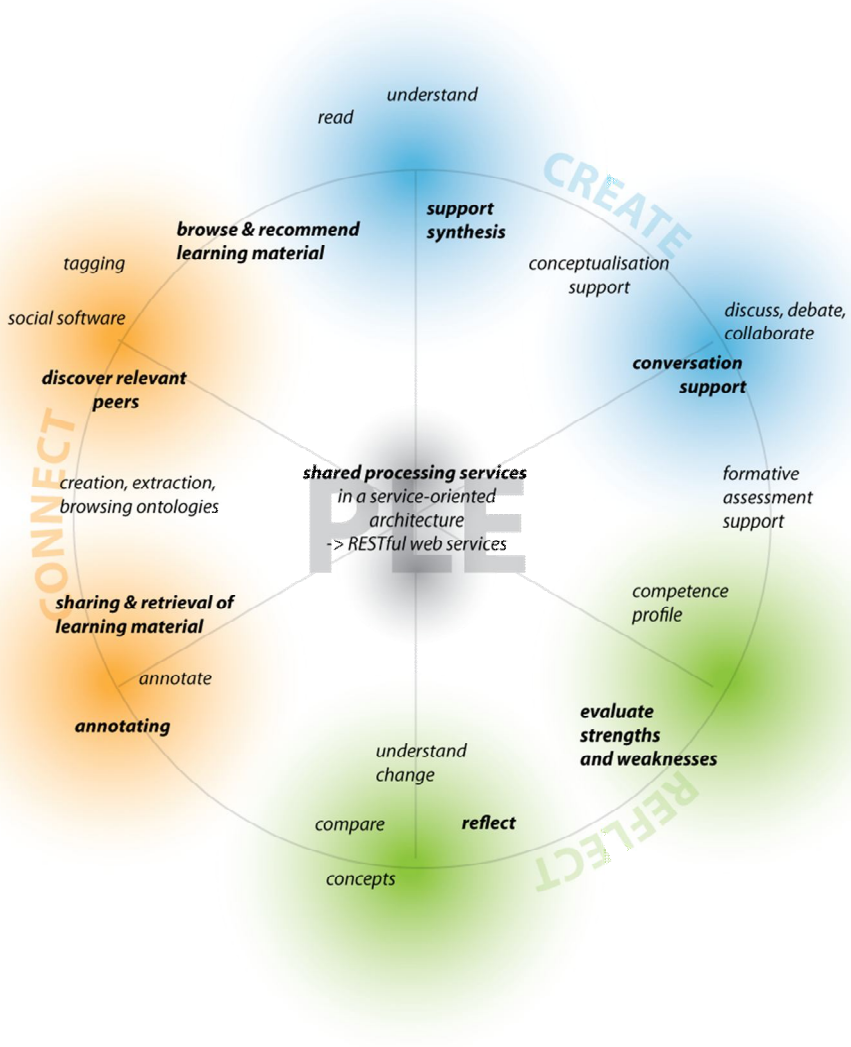

Figure 4: Shared Processing Services Artefacts.

At the beginning, positioning is used to find a starting point about what competences a learner has and which learning goals are set. This profile is evaluated from the evidence brought forward, thus condensing the data into manageable aggregates. This is also about the learner identifying evidence and bringing it forward to the positioning service.

Conceptual monitoring then takes this initial profile and watches it over time and in comparison with peers. The service additionally provides the opportunity to collect intended learning outcomes and literature databases.

The ongoing process is supported by providing feedback on writing summaries (demonstrating that one works with literature and understands it). It also provides evidence material of what the learner

might know. This feeds into the conceptual monitoring and positioning again. The reading loop interfaces with tasks covering the social component and sharing network.

The interaction analysis is giving feedback by looking at the communication of users and smaller units of text materials collaboratively. The evidence collected and produced with this feeds into the conceptual monitoring and similarly into the social ontology and tagging activities.

The sharing network and annotation facilities can directly serve the summary writing by providing material that can be summarised and by providing (personalised) browsing and searching facilities. The summary writing tool can also be used to gather annotations. The conceptual evaluations made possible with this can be interfaced with the aggregate results produced by the LSA-based processing services of the conceptual monitoring. The ontology construction through annotation interfaces with the social networking services. Tags and their relation with concepts and resources relate strongly to positioning and conceptual development as this could be a valuable source for extracting condensed evidence and finding semantic structures of what has been learnt in an informal way.

Trade-offs

Trade-offs of technological and architectural decisions can be, for example, an overhead in communication messages and their size. This is accepted because of the generated surplus in interoperability and reuse, and the preferred loosely-coupled design of the services. Another trade-off is that developed services can differ in their program complexity and therefore documentation and reusability of the code. That is why development and documentation guidelines have been defined (see D2.1 and D2.2) which are needed for describing services, which are called from different partners. Calling services over networks also have the disadvantages of message delays and connection problems. These have to be kept in mind when orchestrating different services into a workflow. As the Internet of today is a reliable infrastructure this is not a major problem, but network error handling routines have to be considered. Therefore, as most LSA-based computation is time consuming, results have to be displayed asynchronously.

Learning materials can be expressed in various types of data formats, thus creating the need for text transformation routines (e.g. plain text serves as input for LSA). By using widgets it is possible to develop independent from the platform, but the depth of arranging widgets is limited to the functionality of the host learning environment. As the current widget container has some problems in considering authorization mechanisms, the platform's own authentication mechanisms along with third-party services are used (e.g. OAuth). The evidence collection of a learner is technically a mediation service (created by linking different services together), with the drawback of a poorer level of performance in comparison to aggregated data.

Data Privacy

Using data from different sources carries with it the risk of running into privacy issues. For doing LSA-based positioning, the learner has to offer the service textual material written by him alone. A learner has to be assured that this very private data is only used for doing computations and is not – in any form – accessible by third parties. Furthermore, a learner has to have as much control as possible over the amount of information visible to others. Therefore, privacy policies must be written explaining exactly what information the service will collect and how it might be used. It has also to be assured that, by externalizing information to the public domain, no inference can be drawn to the individual (unless a learner is intending otherwise). Authentication is ensured by password-protected logins, while challenge-based access control handles authorisation issues. Finally, the learner needs to have the option to delete his private data at any time and unsubscribe from the community.

5. Validation and Dissemination Layer

This section extends the validation and dissemination strategies described in the most recent WP7 and WP8 deliverables (D7.2, D8.2 and D8.3) to address integration planning since those deliverables were completed, specifically:

- Integrated approach to dissemination and validation activities with stakeholders external to the project
- Validation of the integrated scenario, the scenario threads and the integrated LTfLL services

Dissemination and validation activities – working together

An important aspect of the LTfLL project is how the project reaches out to various stakeholder communities so that the project has value beyond the partners and duration of the project. This is necessary to secure the longer-term impact and adoption of results produced by the project. The technologies and techniques used in the LTfLL project are still to be introduced and established in the educational domain. The stakeholders in this project will need to be made aware of the existence and benefits of this research. The Consortium has identified a number of synergies between (1) dissemination and training, and (2) dissemination and validation with external stakeholders.

(1) Joint dissemination and training activities

The 'one package' approach to dissemination/training is described in detail in the additional Month 18 WP8 report and is outlined in the **dissemination strategy** (see below).

(2) Joint dissemination and validation activities

In the future, dissemination of results of the LTfLL project, as well as validation activities, will be used to introduce external stakeholders to the LTfLL services. This will be used to acquire feedback

from these stakeholder groups. That this combined approach is feasible has already been shown in the first validation round (D7.2), where we used the scenarios to both inform stakeholders (e.g. learners, tutors, teachers and teaching managers) in partner institutions as well as to get feedback informing the further design of the services.

Whereas we have used this strategy until now only with stakeholders within the partner organizations, we will now use it also with external stakeholders. In order to organize these combined dissemination and validation activities, a close collaboration between WP8 and WP7 will be established.

This collaboration is guided by three steps that provide a path to lead stakeholders from being aware about the project to adopting its outputs, as follows:

1. Awareness raising – Publicising the benefits and possible uses of the LTfLL services to the world at large and make an inventory of how external stakeholders may want to use them in their educational practice.

2. Engaging interested parties – Promote and stimulate reflection on possible usage of the project's outputs in different contexts via discussion with and demonstration to stakeholders outside the projects' consortium.

3. Providing 'next steps' so that potential external stakeholders are able to experiment with the services and see the value that these services add to online learning environments. Stakeholders are invited to bring in their suggestions or to co-develop with LTfLL partners.

By executing these activities, several types of lead users within stakeholder communities will be identified and contacted in order to convince them of the business value of the LTfLL services for their educational practice.

Validation of the integrated scenario

The validation planning in deliverable D7.2 is updated in this section to include integration aspects. The goals of the second and third validation round are extended to include:

- **joint validation/dissemination activities** with potential lead users and stakeholders external to the partner institutions;
- **validation of the integrated scenario**, to clarify whether these integrated services will meet stakeholder needs and to establish the requirements for their introduction in institutional and extra-institutional educational settings;
- **validation of the integrated services**, to investigate stakeholder interactions with the suite of services and their workflow in using the services.

Joint validation/dissemination activities

As part of the Dissemination Strategy, we have identified how we can use dissemination activities to probe the views of external stakeholders. Some examples are provided here, more details are given in the extra WP8 report:

Dissemination activity	Linked validation
Workshops associated with professional associations/conferences (main purposes: awareness raising, training)	Qualitative feedback section in event; joint validation/feedback form
Seeding LTfLL into existing on-line forums	Harvesting the forums for qualitative data
LTfLL dedicated on-line community	Seeding and monitoring discussion topics
Meetings with potential lead users	Semi-structured interviews contributing to a meeting report; record of subsequent contact

Validation of integrated scenario

Section 2 of this report (methodological layer) described an integrated scenario in the IT domain to show how the LTfLL services can work together. The integrated scenario will be elaborated in D3.3 to specify in more detail how stakeholders are expected to use the services, in combinations of at least 2 services (expressed in this document as scenario threads) to cover specific requirements within different educational or lifelong learning contexts.

The individual services will be validated as planned in round 2. The validation of the combinations or 'scenario threads' will be done in round 3 with D7.4 as its final report. Within round 3 we first start with conceptual validation of possible combinations of services. Feedback from external stakeholders will be organised to reflect their needs, to provide more information about the workflow patterns and to determine useful combinations of services. This will be used as input for D3.3. The agreed combinations of services will then be elaborated using the Scenario Base Design approach to plan the validations (round 3) within an educational setting. Information gathered in the final validation round will result in the promised roadmap at the end of the project.

Compared with the approach used in round 1, in round 3 we will have a much better starting position because of the availability of working services in one integrated environment. Using this, we can provide stakeholders with an experience close to 'real life'. We can use the combination of focus groups and semi-structured interviews as was done in round 1, but now add to the story telling real service demonstrations in educational contexts. This is done in the first phase of round 3. In the second phase of round 3 we will validate agreed combinations of services within the partner institutions.

Validation of the integrated services

In the round 2 validation, the developed software will be validated and embedded within the project's Personal Learning Environment (PLE: Elgg), rather than as stand-alone modules. The results of this validation will be used to prepare the updates for the second versions of the services.

In the round 3 validation, the LTfLL services are expected to interoperate, i.e. outputs from one service may become the inputs to another, according to the agreed scenario threads. This implies that in this round, we will validate the interoperating services within educational settings.

6. Conclusions

This report presented the LTfLL approach for integrating the services developed in the project. This four-layer approach comprises theoretical, methodological, technical, and validation and dissemination perspectives.

We believe that both the ideas presented in this report, as well as the process involved in its creation, have, and will continue to have, a positive impact on recognizing the potentialities, strengths and limitations of the project. The most evident benefit of this integration approach is a common framework in which the theoretical background, the methodology and the use of Language Technologies converge to solve practical problems. Technically, the outcome of the integration report is that a loosely-coupled service oriented infrastructure can be realized and plugged-into an existing learning environment platform.

As planned, we are currently working on the validation of the individual services. The integration approach will build further on this. In round 3 of the validation, scenarios that comprise of combinations of at least two services for specific contexts (scenario threads), will be described, verified and validated with relevant stakeholders.

This integration approach is helping partners to work more closely and benefit from each others expertise in different fields, as well as providing extended common ground, which are in fact assets of the LTfLL consortium.

References

Bakhtin, M.M. (1981). *The Dialogic Imagination: Four Essays*, University of Texas Press.

Bakhtin, M.M. (1984), *Problems of Dostoevsky's Poetics*, Theory and History of Literature Series, vol. 8, Minneapolis.

Bakhtin, M.M. (1986) *Speech Genres and Other Late Essays*, University of Texas Press, 1986.

Bransford, J., Brown, A. L., & Cocking, R. R. (2000). *How People Learn: Brain, Mind, Experience, and School (expanded edition)*, Washington: National Academy Press.

Brown, J.S. & Duguid, P. (1991). Organizational Learning and Communities-of-Practice: Toward a Unified View of Working, Learning, and Innovation, *Organization Science*, *2* (1), 40-57.

Elgg (2009). http://elgg.org, last accessed at 2009-09-17.

Ertmer, P. A., Newby, T. J. (1993). Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. *Performance Improvement Quarterly,* 6 (4), 50-70.

Gruber, T.R. (1993). *A translation approach to portable ontologies. Knowledge Acquisition*, Vol. 5, No. 2, pp. 199–220.

Jonassen, D. H., McAleese, T. M. R. & Duffy, T. M. (1993). A Manifesto for a constructivist approach to technology in higher education. In Duffy, T. M., Lowyck, J. & Jonassen, D. H. (Eds.) Designing environments for constructive learning*: Implications for instructional design and the use of technology*, Heidelburg, FRG: Springer-Verlag.

Lakoff, G. (1987). *Women, Fire and Dangerous Things – What Categories Reveal about the Mind*. Chicago University Press, Chicago, USA.

Lave, J., Wenger, E. (1991). *Situated Learning: Legitimate Peripheral Participation,* Cambridge University Press.

Mödritscher, F., Wild. F. (2008). *Personalized E-Learning through Environment Design and Collaborative Activities*. In: Proceedings of the 4th Symposium of the Workgroup Human-Computer Interaction and Usability Engineering of the Austrian Computer Society, USAB 2008, Graz, Austria. Lecture Notes in Computer Science, Springer Berlin / Heidelberg.

Palmér, M., Sire, S., Bogdanov, E., Gillet, D., Wild, F. (2009). *Mapping Web Personal Learning Environments*, In: Wild, Kalz, Mueller, Palmer (Eds.): Proceedings of the MUPPLE'09 workshop at the European Conference for Technology Enhanced Learning, Nice, France.

Sawyer, R. K. (Ed.). (2006). *Cambridge handbook of the learning sciences*. New York: Cambridge University Press.

Stahl, G. (2006). *Group Cognition: Computer Support for Building Collaborative Knowledge*. Cambridge: MIT Press.

Van Rosmalen, P., Sloep, P., Kester, L., Brouns, F., De Croock, M., Pannekeet, K., et al. (2008). A learner support model based on peer tutor selection. *Journal of Computer Assisted Learning*, 24(1), 74-86.

Vygotsky, L.S. (1978). *Mind in Society*. Cambridge, MA: Harvard University Press.

Wookie (2009). http://www.getwookie.org, last accessed at 2009-09-17.

Annexes

Annex 1. Methodological Layer: The LTfLL services in an informal learning scenario context

In this annex, we present a learning scenario that describes how the LTfLL services could help a lifelong learner in an informal learning situation.

Emma Zeppin

Emma has been working for many years after studying IT at University. She is ready for a new challenge: she wants to found her own IT-courses firm. She draws up a plan to get there. The first thing she needs to do is to become a student again to get up-to-date in current IT learning materials. She then has to write her own materials, as she decided that her courses need to be on a more practical level then the courses she followed at University. She also needs to be the "dean" of her educational offerings, creating a curriculum and providing services for her students. She also understands that in the beginning she will be the sole tutor in her firm until start-up is over and she can hire staff. Somehow she needs all the help she can get to get things started and needs to make widely known she is doing this. Luckily for her, she is aware of some new developments in education using language technologies that might help her to pull this off. She wants her educational offerings to stand out from the crowd and also for her students to benefit from new tools available in the assistance of learning.

In order to update her IT-knowledge she searches for accredited new University level IT curricula. She finds a curriculum recommendations service (LTfLL-WP4.1) to which she submits the materials she studied herself (portfolio). She receives an overview of courses she would need to follow to get up-to-date again.

She searches for the course materials in a CSF service (LTfLL-WP6.1) and finds them. She studies these University level materials, but as she is planning to provide courses on a more practical level, she has to rewrite them. However, she needs to make sure the quality of the materials will be acceptable and that they are well written and complete, showing her to have a comprehensive understanding of the materials.

She therefore creates topic spaces (LTfLL-WP4.2) from the original materials she downloaded from the CSF, based on the topics addressed in her courses. She lets the service analyze the materials into a model. Next, she submits the materials she has written which are then checked for topic coverage. However, she knows this is not the only test she can submit her materials to so she also submits the same documents she has written for feedback on their completeness and coherence to an essay

service (LTfLL-WP5.2). From both services she receives recommendations on how to improve her writings.

In the process of refining her materials, she discusses the recommendations she gets with people in her social network (LTfLL-WP6.1). Based on the questions she asks, she receives recommendations on additional materials she might look into and people to contact to discuss her issues. She prefers to discuss by means of a certain chat and forum service (LTfLL-WP5.1) that analyzes chats and forum discussion for completeness of topic coverage, so she knows she hasn't forgotten to discuss essential issues.

When she has finished re-writing she is ready to provide her students with the new course's materials. She wants to give back materials to the source they came from so she adds to the content of the CSF by submitting the materials she wrote and the remarks she got from her chats with other people on how to use the materials.

She adds to the topic spaces of LTfLL-WP4.2 by leaving her topics in place for her students to use when they follow her courses themselves and she needs to tutor them.

She also submits the curriculum of her courses to the curriculum service of LTfLLWP4.1, so her materials and institution can be found when other learners search for materials.

She is now fairly confident they are adjusted to her audience and are complete and up-to-date. Furthermore, she has some novel services her students can use themselves and a presence in her social network and the services she used to create her offerings. She is now ready to proceed with starting her own business.

Annex 2. Technical Layer: Survey about used software techniques and developments

This document should provide basic information on software developments of all work packages to get a better understanding of the possibilities for the technical integration of the different services. This is not an exhaustive list of every piece of code, but the main idea is described to get the overall picture. From that, commonalities and possible ways for the technical integration as well as the degree of complexity will be drawn during the rest of the project.

WP 4.1 - Positioning the Learner

Short description of service (what it is planned the software will do for version 1)	Positioning means analyzing students' portfolios (for now: forum discussion threads) against learning materials of courses to get a feeling about what a student knows and where there are gaps. For that there will be two views on the system: a tutor and a student view. Tutors can manage courses (create/edit/view etc.), can upload learning materials to courses, and can manage the positioning service (LSA space creation etc.). Students upload their CV, choose a course and have to do a questionnaire (to query what they know about the learning outcomes of the course) to get positioned. Tutor initializes the positioning service (some LSA computation), gets recommendations from the system, corrects the system's output (if needed) and gives feedback to the student.
Used technologies (even if obvious)	HTML, CSS, JavaScript, AJAX, XML, PHP, R, MySQL, Apache, REST, R/Apache module
How is the service designed?	3 Layers: - GUI: Webpages (a sample implementation of a user interface) with HTML, CSS, JavaScript, PHP on an Apache webserver - Logic: PHP and R web-services (therefore the R/Apache module -> allows to integrate R in Apache and serves data over HTTP), calling these webservices REST-styled, e.g. you know a URL with parameters, you get back customized XML code (to be defined) -> so we keep it simple! - Data: MySQL database for the obvious things, for the LSA spaces (very big): storage on file system and link in database to them
Are there standardized interfaces which can be called from other WP services? If not, how can the output of your service be accessed by another?	There will be a documentation of the REST-styled web-services (in something similar to WSDL perhaps). So which URL with which parameters to call and what it does and what you get back. Like getting back all the spaces exists in one domain, e.g.: call: **Fout! De hyperlinkverwijzing is ongeldig.** you get back: <WSR:webServiceResponse> <ltfll:space id="4"> <ltfll:title>test space 1</ltfll:title> <ltfll:description>space with pharmadata, basic preprocessing</ltfll:description> <ltfll:course_id>1</ltfll:course_id> <ltfll:language>english</ltfll:language>

	.... </ltfll:space> ...
Is the service installed on the WP2 development server?	Yes, it is currently under development on the augur server. Directory: /usr/local/apache2/htdocs/v1/wp4.1 Directory is under version control (SVN) with our SourceForge repository.
Is there a demo? If yes, please give here the address (URL), if no, when will a first version be available?	An old one, but at the Nice meeting there will be a new demo here: http://augur.wu.ac.at/v1/wp4.1
What background data is used for the service?	For the LSA stuff: Forum discussion threads from Manchester, MEDLINE corpus as background.
Describe one or two sub-services of your system (maybe important ones would be best), how to access them and what is getting in and out	1) The example of getting a list of generated LSA spaces can be seen above 2) example (not implemented yet) call: http://<host>/wp4.1/webservices/positioning.rws?user_id=5&course_id=3 getting back: <WSR:webServiceResponse> <ltfll:positioning user_id=5> <ltfll:course id=3> <ltfll:score>Excellent</ltfll:score> <ltfll:feedback>You seem to understand every concept of the course</ltfll:feedback> <ltfll:question id=1> <ltfll:score>Excellent</ltfll:score> <ltfll:feedback>Your answer to question 1 is flawless</ltfll:feedback> </ltfll:question> <ltfll:question id=2> <ltfll:score>Excellent</ltfll:score> <ltfll:feedback>Are you interested in a teaching position?</ltfll:feedback> </ltfll:question> <ltfll:question id=3>

	<ltfll:score>Excellent</ltfll:score> <ltfll:feedback>If you run for president, you have my vote</ltfll:feedback> </ltfll:question> </ltfll:course> </ltfll:positioning> </WSR:webServiceResponse>
Services that can be used by other WPs (if you can think of any)	The whole LSA computation material and the space management. Documentation will be written detailing which services exist and how to call them. There will be, for example, a service as described in the former paragraph where you can easily build a space by calling a web-service and easily configure the space creation with parameters. Directly related to WP4.1 there will be the course management, learning material management, and learner documents management as well as positioning and feedback modules.

WP 4.2 - Conceptual Development

Short description of service (what it is planned the software will do for version 1)	Monitoring conceptual development means creating a to-the-point representation of what a learner knows constructed from the evidence presented. The representation is a conceptual graph containing concepts and their closeness. The service developed for version 1 allows us to inspect the conceptual graphs of a learner at different points in time and to compare it with other graphs collected (graphs of other learners, of a literature database, etc.).
Used technologies (even if obvious)	Montoring intelligence: - Latent Semantic Analysis - Network Analysis - Cluster Analysis Visualisation: - fossa: dynamic graph rendering with class based on prefuse flare - graphML: mark-up language for graphs Services: - REST-ful webservices built with R serve and R mod apache

How is the service designed?	Three-tier layer
Are there standardized interfaces which can be called from other WP services? If not, how can the output of your service be accessed by another?	termsims.rws: input: free text (parameter 'text'), output: graphML agreement.rws: input: url1, url2 pointing to two graphML sources, output: graphML with differences marked visually fossa.swf: dynamic graph rendering: flashvars parameter text = url to a graphML source; renders a graph visually keywordExtractor.rws: input: GET parameter text, output: xml with <keywords><keyword freq='1'>keywordname</keyword></keywords> simpleConceptMap.rws: input: keyword XML, output: png with a histogram of the frequency
Is the service installed on the WP2 development server?	yes
Is there a demo? If yes, please give here the address (URL), if no, when will a first version be available?	work in progress, version being prepared for the consortium meeting previous version is at augur/condev/
What background data is used for the service?	skin space at the moment
Describe one or two sub-services of your system (maybe important ones would be best), how to access them and what is getting in and out	see above: interfaces
Services that can be used by other WPs (if you can think of any)	see above: interfaces

WP 5.1 - Recommendation Based on Interaction Analysis

Short description of service (what it is planned the software will do for version 1)	The system provides textual and graphical feedback and recommendations based on the analysis of instant messaging and discussion forums interactions. In the second version of the service, there shall be three views of the service, while the first version shall have only the first two views. The students view: students are offered with textual and graphical feedback and recommendations after participating in a course-related chat conversation or discussion forum. The tutor view: for each student, the tutor is presented automatic feedback, that he/she is able to modify. The teacher view: the teacher supplies the subjects to be discussed over chat and forum and is able to see the automated and the tutor's feedback.
Used technologies (even if obvious)	Client: HTML, CSS, Javascript, AJAX, XML, Flex Server: PHP, Apache, Java, Tomcat, AXIS2, MySQL, REST
How is the service designed?	3 Layers: GUI (View): web pages (front-end: HTML, CSS, Javascript, AJAX, Flex; back-end: PHP) Logic: Java and PHP web-services, REST based using AXIS2 and Tomcat for Java or Apache for PHP; data is interchanged between GUI and the services by using JSON or XML Data: MySQL database, Hybernate, XML exports
Are there standardized interfaces which can be called from other WP services?	REST-based calls using JSON or XML as response. The input to the web services is an XML file containing the chat transcript (although other formats are supported: html and text that are automatically converted into XML). Example of input: <Dialog team="1"> <Participants> <Person nickname="User1"/> <Person nickname="User2"/> <Person nickname="User3"/> <Person nickname="User4"/> </Participants> <Topics/>

	<Body> <Turn nickname="User2"> <Utterance genid="1" ref="0" time="07:51:30">hello!</Utterance> </Turn> <Turn nickname="User3"> <Utterance genid="2" ref="0" time="07:53:41">joins the room</Utterance> </Turn> ... </Dialog>
Is the service installed on the WP2 development server?	Not yet. The first stable version of the service shall be uploaded on the WP2 development server by 20th September. Please check the (server-side) software requirements in order to make the deployment process run smoothly.
Is there a demo? If yes, please give here the address (URL), if no, when will a first version be available?	Not yet. The demo shall be available by 20th September).
What background data is used for the service?	Computer Science-oriented chat conversations from PUB-NCIT, Medicine-oriented forum discussions from UNIMAN
Describe one or two sub-services of your system (maybe important ones would be best), how to access them and what is getting in and out	1) Textual feedback web service. Receives input XML and outputs another XML file which is similar to the input but adds the textual feedback at the end of the chat conversation. 2) Graphical feedback web service. Receives input XML and outputs a graphical visualization of the conversation (current version uses SIMILE - CSS + JS, future versions shall use BirdEye - Flex).
Services that can be used by other WPs (if you can think of any)	The NLP pipe as well as other components (such as the speech acts annotation tool, the lexical chains tool, etc.) can be implemented as separate web services (and documented) to be used by the other WPs. However, these web services shall be developed only if requested by the other partners, as they are not needed by WP5.1.

WP 5.2 - Recommendations Based on Assessing Textual Products

Short description of service (what it is planned the software will do for version 1)	In the v1, the learner has to write a synthesis (or summary) about a case study. A feedback is provided to the learner about the synthesis (coherence between sentences, topics/keywords, important sentences in the source text, important content missing). The v1 also allows one to search additional texts (e.g. scientific articles) stored in a database from a search engine.
Used technologies (even if obvious)	Client: HTML, CSS, JavaScript, AJAX, Server: Apache, PHP, MySQL, Perl, LSA (=> C)
How is the service designed?	The user accesses a webpage which is composed of several layers (div). The queries are realized with AJAX: the content of javascript variables send to the server and processed in a php script. The php script can store/extract data from the mysql database and/or use LSA and/or send new data to user. If new data is sent to users, the display of data will manage in javascript on the client station.
Are there standardized interfaces which can be called from other WP services?	Not yet, work in progress
Is the service installed on the WP2 development server?	Yes, the service is on the server. You can look at the code but it is ongoing.
Is there a demo? If yes, please give here the address (URL), if no, when will a first version be available?	An old one, new one with interfaces coming soon
What background data is used for the service?	for the v1 : LSA french corpus (LeMonde or AdultTotal)
Describe one or two sub-services of your system (maybe important ones would be best), how to access them	see above

and what is getting in and out	
Services that can be used by other WPs (if you can think of any)	None without development (ongoing)

WP 6.1 - Creation of a Knowledge Sharing Network

Short description of service (what it is planned the software will do for version 1)	This service provides basic support for managing documents/storage, retrieval, searching, annotation, reasoning, etc. The service is accessible through a uniform API which is the main entry point to the system. All third party components communicate with it by sending requests to and receiving responses from the api. Common supported operations are publishing and retrieval of learning objects (LO) and ontologies, optimized searching for resources, (semi-)automatic annotation of resources. Going down to the implementation details, the service will be exposed as a RESTful web service on the Web. Though it is web oriented, it can be used on a standalone machine by running a local WEB server (Tomcat for example). The advantage of this approach is that the same infrastructure can be used everywhere without modification.
Used technologies (even if obvious)	XML, RDF, Tomcat, CXF, Sesame, Jena, Lucene, CLaRK, Eclipse/GEF
How is the service designed?	A core runtime module integrates the major building blocks of the service: storage module, search module, document processing module, user management and authorisation module. Additionally, a desktop tool for manual annotation and visualisation of resources will be available (work in progress)
Are there standardized interfaces which can be called from other WP services?	The service will be delivered as a RESTful service and will be accompanied by human description of the api and a WADL document if necessary.
Is the service installed on the	No, it is still on a local development environment

WP2 development server?	
Is there a demo? If yes, please give here the address (URL), if no, when will a first version be available?	not yet (for public use)
What background data is used for the service?	
Describe one or two sub-services of your system (maybe important ones would be best), how to access them and what is getting in and out	Semantic Search - external agent (human or machine) can search resources based on its content, semantic annotation or additional metadata. The query is expressed in XML format, allowing the specification of (partial) search terms, alternatives, conjunctions, search in contexts. The result is a list of resource URIs which can be retrieved from the system on demand. Document Annotation - on the base of input document and document type specification, the service performs a series of processes which lead to an enriched semantic (and syntactic) annotation document. The concrete processing scenarios are determined by the document type declared. The result can be stored in the document repository and/or retrieved by the user initiating the action.
Services that can be used by other WPs (if you can think of any)	

WP 6.2a - Adding a Social Component to the Public Knowledge

Short description of service (what it is planned the software will do for version 1)	Enrich existing domain ontologies using information from social networks, support knowledge discovery by user friendly ontology browsing using hypergraphs, automatically associate tags with concepts. For more details see the various documents from WP6.2.
Used technologies (even if obvious)	tomcat, axis2, java, pellet, sesame, mulgara, javascript, html, jit (javascript visualization framework)
How is the service	3 Layers:

designed?	View Layer: widgets (front-end: HTML, CSS, Javascript, AJAX) Application Logic Layer: AXIS2 web-services, REST based using AXIS2 and Tomcat for Java; data is interchanged between GUI and the services by using JSON or XMLwith SOAP. Data layer: The Sesame RDF repository using either the sesame native format, or mulgara for larger data sets
Are there standardized interfaces which can be called from other WP services?	SOAP and REST-style services described by WSDL's available at: http://augur.wu-wien.ac.at:8080/wp62_axis/services/listServices By using the WSDL2 support in axis2 all the web services can be approached with either a SOAP style interface or REST. To acquire json output from the services the parameter 'response' needs to be set to 'json'.
Is the service installed on the WP2 development server?	yes
Is there a demo? If yes, please give here the address (URL), if no, when will a first version be available?	no functional demo's at this moment.
What background data is used for the service?	Aggegated RDF-data from various sources: - dbpedia - yago - crawled data from social networks converted into RDF - lt4el ontology and lexica
Describe one or two sub-services of your system (maybe important ones would be best), how to access them and what is getting in and out	1) Ontology browsing - A user opens a widget that contains a javascript-based visualisation. This visualisation requests a graphml file from a web service and can send additional queries made through the interface in json to the web service to influence the returned graphml-document. 2) Ontology enrichment - An ontology is fed to the system in either OWL or RDF. The service queries various sources (other ontologies,

	rdf instances, lexica, etc) stored in an RDF-store and augments the seed ontology. The enriched ontology then gets returned or is made available through some URI.

WP 6.2b - Adding a Social Component to the Public Knowledge

Short description of service (what it is planned the software will do for version 1)	Extract information about the user's social network from some social networking applications, index the data in semantic repositories, perform search and recommendation on the semantic data, export the user's profile into a semantic portable format.
Used technologies (even if obvious)	Python based technologies: python, mysql-python, pysparse (sparse matrix), python API's for social networks like delicious and youtube, cherrypy (for webservices), rdfalchemy for working with semantic data Sesame - semantic repository Mysql - database Wordpress for widgets - php, mysql, javascript, html
How is the service designed?	3 Layers: GUI (View): web pages (front-end: HTML, CSS, JAvascript, AJAX) - widgets deployed in wordpress Logic: REST web-services using CherryPy - data changed using JSON and GraphML Data: Sesame RDF repository stored to disk in the sesame native format
Are there standardized interfaces which can be called from other WP services?	Web-services
Is the service installed on the WP2 development server?	Not yet
Is there a demo?	demo will be ready for the meeting in Nice

If yes, please give here the address (URL), if no, when will a first version be available?	
What background data is used for the service?	crawled data personalized for each user extracted from youtube, delicious, etc..
Describe one or two sub-services of your system (maybe important ones would be best), how to access them and what is getting in and out	Search for users: HTTP GET request <type>/<format>/?usr=<user>&pw=<password>&n=<number of results>&tags=<list of tags>, where - type – the type of search "users" or "resources"; - format – how the answer is returned: „graphML" or „XMLlist" ; - user - the user account; - password – the password; - number of results - how many results you actually want; - tags – the actual tags you're searching for Generate APML profile - generate the profile of the user based on the social network around him
Services that can be used by other WPs (if you can think of any)	