Master's thesis

Foreign-language Learning Environment using Web 2.0 Technologies

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Masterarbeit

Lernumgebung zum Erlernen von Fremdsprachen unter Verwendung von Web 2.0-Technologien

Version vom 7. Mai 2012

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Abstract

We are facing a time, where the application of technology becomes a major factor in the educational system. Nowadays learning should offer the possibility to learn at home, while travelling, at a conference or somewhere else. E-Learning is affordable, saves time, produces measurable results and it can be done at any geographic location and it is available when and where it is needed. The development of E-Learning is rapid and E-Learning is an attractive and efficient way of today's education. Those needs of the community regarding E-Learning are the basis of this work. In addition such a flexible, affordable E-Learning tool should support social aspects, like social networking as well. An E-Learning system should provide some functionalities, like communication and collaboration functions, which not just have the focus on learning and training to make it more interesting for a potential user.

One reason for developing a low-cost and open-source E-Learning environment is the contribution to developing countries and institutions who can not effort to spend money on tools and services, but want to use computer-assisted language learning and training. So the idea was born to implement an E-Learning platform for learning and training English as a second language, including social networking to encourage collaboration and interaction in several learning scenarios and in the private area of each user. Language learning is based on teaching and learning, learning by doing (training), discussion groups, audio and visual, reading and listening. The tool is a mashup of different services to create a Web-based environment that is easy to use.

After an extensive evaluation phase of pre-selected platforms, the Liferay portal software was chosen as the basis for the prototype and adapted for the special requirements of users who want to learn and train their language skills. Within the portal, existing Web 2.0 applications were integrated and combined to allow the realisation of previous specified requirements. The implemented learning environment provides communication functions (e.g. chat, mail, forum), collaboration functions (e.g. collaborative writing, wiki), coordination functions (e.g. calendar, polls), publishing functions (e.g. documents, images, videos) and quality functions (e.g. evaluate provided learning material). Further the language learning prototype supports learning and training in general, with the specific application domain English as a second language. The use of web 2.0 technologies provides a flexible tool supporting different learning settings. Further it is complemented with teaching and training materials that are available on the web and it serves as an information database. The prototype acts as a virtual environment for self-study and can be used along with regular classes as well. Thus, this prototype is a significant contribution to the community.

Kurzfassung

Wir befinden uns in einer Zeit, in der die Anwendung von Technologien im Bildungssystem mehr und mehr an Bedeutung gewinnt. Heutzutage muss man die Möglichkeit haben von zu Hause aus, während dem Reisen und von wo aus auch immer zu lernen. E-Learning ist leistbar, spart Zeit, produziert messbare Ergebnisse und ist verfügbar, wann und wo es gebraucht wird. Die Entwicklung von E-Learning ist schnell und ein attraktiver und effizienter Weg im Bereich der heutigen Aus- und Weiterbildung. Diese Bedürfnisse der Gemeinschaft in Bezug auf Lernen sind die Grundlage dieser Arbeit. Zusätzlich sollte eine flexible und leistbare Lernumgebung auch soziale Aspekte, wie Social Networking unterstützen. Um es für einen potenziellen Benutzer interessanter zu machen, darf eine computergestützte Lernumgebung den Fokus nicht nur auf das Lernen an sich haben.

Ein Grund für die Entwicklung einer low-cost und open-source Lernumgebung ist die Unterstützung von Entwicklungsländern und Institutionen, die nicht die nötigen Mittel für den Kauf äquivalenter Tools zur Verfügung haben, aber computer gestütztes Lernen nützen wollen. So wurde die Idee geboren eine E-Learning Plattform zum Aneignen von Sprachkenntnissen in Englisch zu entwickeln. Diese Lernumgebung soll gleichzeitig auch ein soziales Netzwerk sein, um so Zusammenarbeit und Interaktion in Lernszenarien und auch im privaten Bereich zu fördern. Das Erlernen einer Sprache basiert auf Lehren und Lernen, Gelerntes anwenden, Diskussionsgruppen bilden, Audio-und Videounterstützung, lesen und schreiben. Diese computergestützte Lernumgebung ist ein Mashup aus unterschiedlichen Web 2.0 Anwendungen, welche einfach zu bedienen ist.

Nach einer umfangreichen Bewertungsphase vorausgewählter Plattformen wurde die Liferay Portal-Software als Basis für den Prototypen auserkoren und für die speziellen Anforderungen der Lernumgebung entsprechend angepasst. In das bestehende Liferay-Portal wurden ausgewählte Web 2.0-Anwendungen integriert und entsprechend miteinander kombiniert, um die Realisierung der spezifizierten Anforderungen zu ermöglichen. Die implementierte Lernumgebung bietet Kommunikationsmöglichkeiten (z.B. Chat, Mail, Forum), Anwendungen zur interaktiven Zusammenarbeit (z.B. kollaboratives Schreiben, Wiki), Koordinationsfunktionen (z.B. Kalender, Umfragen), Publishing-Features (z.B. Dokumente, Bilder, Videos) und Funktionen zum Messen von Qualität (z.B. Bewertung, Feedback). Der Prototyp unterstützt das Lernen und Lehren im Allgemeinen, das spezifizierte Anwendungsgebiet ist Englisch als Zweitsprache. Der Einsatz von Web 2.0-Technologien bietet ein flexibles Werkzeug zur Unterstützung von diversen Lernszenarien. Weiters stellt der Prototyp Lernmaterialien, die im Web frei verfügbar sind, zusammengefasst dar und dient somit als Informationsquelle. Die Lernumgebung fungiert als virtuelle Umgebung zum Selbststudium oder ist auch neben dem Unterricht einsetzbar. Somit stellt dieser Prototyp einen wesentlichen Beitrag für die Gemeinschaft dar.

Statutory Declaration

I declare that I have authored this thesis independently, that I have not used other than the declared sources and resources, and that I have explicitly marked all material which has been quoted either literally or by content from the used sources.

Place	Date	Signature

Eidesstattliche Erklärung

Ich erkläre an Eides statt, dass ich die vorliegende Arbeit selbstständig verfasst, andere als die angegebenen Quellen und Hilfsmittel nicht benutzt, und die den benutzten Quellen wörtlich und inhaltlich entnommene Stellen als solche kenntlich gemacht habe.

Ort	Datum	Unterschrift

Table of Contents

List of Figures

List of Tables

List of Listings

List of Abbreviations

iJET	International Journal of Engineering & Technology
ICL	Interactive Collaborative Learning
IMS	Instructional Management System
IDE	Integrated Development Environment
LLEARN	Language Learning Environment and Resource Network
CAI	Computer Aided Instruction
CAD	Canadian Dollar
EFL	English as a Foreign Language
EFLT	English as a Foreign Language Teaching
CALL	Computer Assisted Language Learning
OECD	Organisation for Economic Co-operation and Development
LMS	Learning Management System
ICT	Information and Communication Technology
EEDU	E-Education
DBMS	Database Management System
HTML	HyperText Markup Language
HTTP	HyperText Transfer Protocol
XHTML	eXtensible HyperText Markup Language
XML	Extensible Markup Language
PHP	Hypertext Preprocessor
WSDL	Web Service Definition Language
RDF	Resource Description Framework
RDFS	Resource Description Framework Schema
OWL	Web Ontology Language
BBS	Bulletin Board System
CEF	Common Educational Framework
WBCMS	Web based course management systems
SCORM	Shareable Content Object Reference Model
KMWBLE	Knowledge Management in Web based Learning Environment
WD^2L	Web-based Distance Distributed or online Learning
QA	Quality Assurance
WILE	Web-Integrated Learning Environment
API	Application Programming Interface
YUI	Yahoo User Interface
CSS	Cascading Style Sheet

DHTML	Dyncmic HTML
JRE	Java Runtime Environment
AJAX	Asynchronous JavaScript Technology and XML
SDK	Software Development Kit
SMS	Short Message Service
PC	Personal Computer
PLE	Personal Learning Environment
JDBC	Java Database Connectivity
SEO	Search Engine Optimization
CMS	Content Management System
REST	Representational State Transfer
JSON	JavaScript Object Notation
WAR	Web application ARchive
SOA	Service Oriented Architecture
UI	User Interface
BIST	Built-In Self-Testing
TT	The Turbo Tester
OIL	Ontology Inference Layer
RDQL	RDF Data Query Language
CAA	Computer Aides Assessment
OS	Operating System
EJB	Enterprise JavaBeans
JVM	Java Virtual Machine
JDBC	Java Database Connectivity
JMS	Java Message Service
JAAS	Java Authentication and Authorization Service
RIA	Rich Internet Application
ARIADNE	Alliance of Remote Instructional Authoring and Distribution Networks for Europe

Chapter 1

Introduction

The present of learning is strongly influenced by technology, more specifically by Information and Communication Technology (ICT). This affects the learning of children and also the current generation of adults. A very large number of different systems to deliver online education is available and already used in education. E-Learning is not our future, it is already our present. The world is rushing and every member of the community has to be more and more flexible and so also flexible E-Learning tools are needed to fit in, when there is time.

Learning and teaching strategies have been significantly influenced by latest technologies, which have altered how information is presented and how students interact with that information (Chang & Guetl, 2010). Modern educational strategies have been developed to include aspects such as self-directed learning, collaborative learning, experiential-based learning, actively participating and content creation. Teachers and students must have the freedom to choose their preferred tools and learning content within the learning process anywhere and any time. (Gütl & Chang, 2008)

1.1 Background and Motivation

Language learning occurs through social interaction and in language learning environments, language is the medium of communication used for task completion and the content to be learned. In foreign language learning, environments mediated by information technology play an essential role. The use of technology affects the learning of language and culture. (Adair-Hauck, Willingham-MacLain, & Earnest-Youngs, 2000; Gerbault, 2002; Kern, 2006)

An E-learning environment needs to cover three areas: technology, pedagogy and social behaviour, as illustrated in figure 1.1. The main focused research question was how to balance those three parts in a way, that all the aspects are covered by the learning environment.

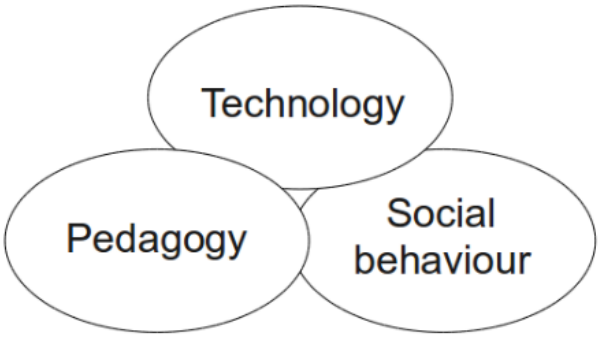


Figure 1.1: Research Triangle, derived from Khan (2005)

The younger generation of Internet users is rewriting the rules of social interaction and the way business is conducted by utilising Web 2.0 technologies. With the advent of electronic media and Web 2.0 tools such as wikis, blogs and social bookmarking, new and ingenious methods of social interaction across geographic borders and industry silos are being created. (Fu, Liu, & Wang, 2008)

Because of the advancements in ICT combined with the global use of these technologies, the evolution from the Web 1.0, which served as a source of information and information repository, to the Web 2.0 with dynamic user interaction, social networking and community building has affected many aspects of E-Learning. The learning potential afforded by Web 2.0 technologies in support of information sharing, communication, networking and collaboration (Wiki, Blog, Skype) transcends time and space, linking individuals in various and vast groups of networked participants. E-Learning 2.0 is learning in communities and this powers up the potential for global, interactive knowledge sharing, construction, and distribution across diverse groups intersecting countries and cultures. (Chen, Hsu, & Caropreso, 2009)

The goal of the master's thesis *Foreign-language learning environment using web 2.0 technologies* was the implementation of a flexible, low-cost and functional E-Learning prototype for language learning using and flexible combining pre-existing Web 2.0 tools.

1.2 Overview of Chapters

Chapter 2 first presents the theoretical background of learning and describes the learner-centered approach regarding learning. Language learning, in particular second language acquisition, learning and training is the second part of this chapter and the differences in first and second language acquisition are discussed.

Chapter 3 deals with the whole E-Learning area. First it gives a theoretical overview about the different technology enhanced learning strategies, then it outlines E-Learning as a process, discusses the according standards regarding E-Learning and mentions quality as a core value of every E-Learning system. Finally the main advantages and disadvantages of E-Learning are presented.

Chapter 4 lists trends and latest technologies in E-Learning. Further it summarises the most important characteristics of educational application which needs to be taken into consideration while designing an E-Learning environment. Some approaches, concepts and frameworks are presented and finally some actually used E-Learning systems and related work regarding E-Learning environments for language learning are introduced.

Chapter 5 outlines the requirements of the prototype and illustrates the selection process to find the most suitable technology for implementing the prototype.

Chapter 6 presents the Liferay portal software as the basis for the prototype and describes the implemented prototype in detail. It presents the architecture, developing details, the configuration of the Liferay portal, occurred problems and an evaluation of the developer's point of view.

Chapter 7 shows the functionality of the prototype from the administrator's view, the teacher's view and the learner's view using screen-shots of the prototype in operation mode. Further some selected tools provided by the prototype are presented.

Chapter 8 gives a summary of the findings and results of this master's thesis and represents possibilities for further development and improvement of the prototype.

In the Appendix useful documents for working and developing with Liferay are listed and the development environment, the installation and startup process is described detailed.

Chapter 2

Education and Technology in Language Learning

Chang and Gütl (2008, p. 1) stated,

> *"Modern learning approaches must take into account social and cultural aspects as well as the individual's profile including task and role-based aspects, interests, knowledge state, short-term learning objectives and long-term career goals. Not only processing and acquiring knowledge is a key to a modern learning approach, but also content creation, collaboration and community-based practice for knowledge and skills development are important success factors".*

2.1 Learning in Theory

Theory is a hypothesis that describes, speculates or defines a relation between a set of facts through principles, policies, beliefs or assumptions. Learning is acquiring knowledge and elaboration is a theory about learning, which focus is on how you come to know things. Many mechanisms like assimilation, accommodation and equilibration together constitute a theory of learning. (Orey, 2010)

The most common learning styles are visual (seeing), auditory (listening), reading and writing and kinesthetic (touching) and most people combine the styles of learning. E-Learning has to cover all learning types and it comes in many variation and combinations to manage this. (Wikipedia, 2011)

2.1.1 Knowledge Construction

In course of the relationship between technology and constructivism, the implementation of each one benefiting the other and the aim of both is to create a learning environment

where learners may interact with each other in creating knowledge. The range of tools which provide learning opportunities outside school has changed greatly in the recent years. Web 2.0 tools are based on the concept of 'Web as participation platform' and enable contemporary teachers to provide richer and more exciting learning environment for their students. (Chen et al., 2009)

A learning community must be formed within an environment in which community members trust each other and feel comfortable in sharing knowledge, feelings, experiences, and values and an learning environment must be supportive and resourceful to facilitate knowledge construction and application. Social construction of knowledge involves many and varied factors: participation in a trusting community engaged in purposeful activities, effective guidance and leadership of an instructor (teacher) and provide appropriate orientations, supports and guidance if groups are able to interact positively and productively. (Chen et al., 2009)

Learning is a lifelong endeavour and there are links and differences between types of learning and therefore the definitions of those types are specified in the following collection.

Formal, Non-formal and Informal Learning

Those forms of learning are defined by the Organisation for Economic Co-operation and Development (OECD) for lifelong learning. (Wikipedia, 2011)

Formal learning is intentional, organised and structured and its opportunities are usually arranged by institutions. (Eaton, 2010)

Non-formal learning is usually organised in some way, even if it is loosely organised. (Eaton, 2010)

Informal learning is more learning than the absorption of 'explicit' knowledge codified in texts and delivered during formal courses and consists of access to 'tacit' or implicit knowledge. Informal learning involves all that is learned throughout life in day-to-day processes. (Mason & Rennie, 2007)

Synchronous and Asynchronous Learning

Synchronous and asynchronous learning are two basic types of learning, which are commonly compared with each other.

Synchronous learning refers to a group of people and happens when two or more people are communicating in real time within a classroom or instant messaging. (Wikipedia, 2011)

Asynchronous learning is student-centered and emphasises the importance of peer-to-peer interactions. It is more flexible, so the teaching takes place at one time and is presented to the learners to a suitable time via Email or forum. (Wikipedia, 2011)

Supervised and Unsupervised Learning

Supervised and unsupervised learning differ in the causal structure of the model.

Supervised learning is characterised as intentional, in that learners actively search for rules and are explicitly aware of the rule they are considering. (Gureckis & Love, 2003)

Unsupervised learning is an incidental, undirected, stimulus driven and incremental accrual of information. (Gureckis & Love, 2003)

Collaborative and Cooperative Learning

Collaborative and cooperative learning are processes, where members support and rely on each other and work together to achieve a common goal.

Collaborative learning is a teaching tool where participants work in groups and study in teams and the main goal of it is to motivate students by getting them more actively engaged. (Smith & MacGregor, 1992)

Cooperative learning represents the most carefully structured end of the collaborative learning continuum and the development of interpersonal skills are as important as the learning itself. Learning to cooperate in groups is the key to high quality group work. (Smith & MacGregor, 1992)

2.1.2 Cognitive, Psychological and Pedagogical Aspects of Learning

Different types of learners are using E-Learning systems and therefore it is necessary to provide them with an individualised learning support system. The focus needs to be on learner's cognitive learning process, learning pattern and activities. Based on the learner-centred mode and cognitive learning theory, students should be supported with learning flexibility and adaptability. (Guo, 2008)

From the cognitive aspect, one of the key components of good pedagogy is interaction, whether technology is involved or not. Interaction is an essential ingredient of any learning environment (classroom-based, online education or blended models) and it is a necessary and fundamental process for knowledge acquisition and the development of cognitive and physical skills. It is possible to integrate the techniques and knowledge from cognitive science disciplines to a modern E-Learning framework. (Woo & Reeves, 2007; Barker, 1994)

From the psychological aspect, learning is a psychological experience one receives to make behavioral modifications to improve capabilities while gaining knowledge or skills. (Ekanayake, Karunarathna, & Hewagamage, 2007)

From the pedagogical aspect, technology alone is unable to create a meaningful learning environment unless pedagogy is integrated with technology. For pedagogical reasons it's

desirable to monitor the students progress through learning material, building up models of their knowledge and preferred methods of learning. (Khan, 2005; Gehne, Jesshope, & Zhang, 2001)

Orey (2010) presented some fundamental theories, which provide a common language for instructors and instructional designers. The theories categorise learning and thinking, explain how the mind functions, describe how learning is organised and how knowledge is constructed and recalled:

- Information processing is a theory that is broken down into three memory stores: sensory register, short-term memory and long-term memory. The sensory register consists of five senses: hearing (echoic), seeing (iconic), tactile (touch), olfactory (small) and gustatory (taste). Thinking is done in the short-term memory and when the sensory register is stimulated, the new information is processed there. In the short-term memory new information is combined with existing information in the long-term memory and this can be enhanced through elaboration and repetition. (Orey, 2010)
- Vygotsky's Constructivism theory is based on the fundamental role of social interaction and the development of cognition. (Orey, 2010)
- Bloom's Taxonomy is categorised into three domains of learning: cognitive, affective and psychomotor. The cognitive domain is divided into lower-order skills including remembering, understanding and applying and into higher-order skills including analysing, evaluating and creating. (Orey, 2010)
- Piaget's Constructivism is a learning theory which describes three mechanisms for learning: assimilation, accommodation and equilibration. This theory states that what is learned is organised according to schemas, which are mental representations of something tangible or intangible that can be applied to an object, situation or event. Assimilation begins when new schemas are developed and it refers to the stage in which new knowledge is processed and added to previously existing schemas. Accommodation is an adaptation process and equilibration is created when assimilation and accommodation reach a balance in the mental structures. (Orey, 2010)
- Cognition is about how the brain and the mind works. Most cognitive theories are more conceptual. Situated Cognition theory takes place within a dynamic learning community, which can exist in many environments like home and school, in which each individual can take on a variety of roles (student, teacher, expert). (Orey, 2010)
- Social Constructivism theory bases on assumptions that reality is constructed by human activity, knowledge is created through interactions with others, and their environment and learning are more meaningful when the learner is socially engaged. The theory includes the cognitive tools perspective, idea-based social constructivism, pragmatic or emergent approach and transactional or situated cognition. (Orey, 2010)

2.1.3 Learner-Centered Theories

Traditional learning is teacher-centered pedagogical instruction. The modern learning framework is centered under a student-centered learning management system and thus it is weak in cognitive, emotional, behavioural and social measures. It is important to improve the pedagogical factors under themes of adaptive and personalised E-Learning. (Guo, 2008; Ekanayake et al., 2007)

Orey (2010) describes, that learner-centered theories focus on what the learner brings to the instructional environment. Unique characteristics, that may exist within any learner, are described and strategies to encourage creativity and motivation are provided in the following listing:

- Motivation is a goal-directed behaviour and performance goals focus on getting good grades and mastery goals focus on mastering the learning concept and knowledge. Motivation theory can be categorised as extrinsic and intrinsic and explains what causes people to engage in activity. Extrinsic motivation involves the learners desire for earning reward and avoid punishment and intrinsic motivation is related to the learners curiosity and desire for mastering achievement. (Orey, 2010)
- Gardner's Taxonomy of Multiple Intelligence includes: verbal and linguistic, logical and mathematical, visual and spatial, bodily and kinesthetic, musical, interpersonal, intrapersonal, naturalistic and existential. They enable the ability of an individual to solve problems, create products or provide services. Learning style is the composite of cognitive, affective and physiological factors that serve as relatively stable indicators of how a learner perceives, interacts with and responds to the learning environment. (Orey, 2010)
- Teaching and Learning in the Affective Domain focuses on the learners attitudes, motivation and values and some of the predominant affective domain learning theories include Festinger's cognitive dissonance theory, consistency theories, social judgement theory, social learning theory and functional theory. (Orey, 2010)
- Creativity is the production of novel and appropriate work and is affected by a variety of internal and external factors which are classified in a process-oriented model and in a system-oriented model. The process-oriented model describes cognitive aspects that affect creativity and the system-oriented model describes social and individual aspects. (Orey, 2010)
- Adult Learning includes that learners bring their own life experiences, work experiences, learning experiences, performance affecters' and environmental factors such as time between learning interactions and aging. Learning theories like action learning, experiential learning, project-based learning and self-directed learning are related to adult learning. (Orey, 2010)

A learner-centered approach includes concepts of self-education and life-long education. Teachers need to change the traditional roles, from tellers to facilitators and from material users to teaching material creators to promote learners' constructive self-learning.

Students' needs and learning styles are analysed and used for selecting course content and teaching methodologies. (Nonkukhetkhong, Baldauf, & Moni, 2006)

Evaluation is an ongoing process in every stage of teaching and learning and self-assessment by each student is regarded as important as assessment by teachers. It is important to place more responsibility in the hands of the students to manage their own learning and the teachers are taking roles as facilitators of knowledge to help learners. Teachers can foster learner autonomy by creating and maintaining a learning environment through communicative tasks. This allows students to develop their language and learning skills to become autonomous learners. (Nonkukhetkhong et al., 2006)

But not all learners, especially young learners, will not always be able to make their own choices about their own learning process. Therefore teachers have to be familiar with a wide range of teaching methodologies, learning materials, study options and be flexible and adaptable. (Nonkukhetkhong et al., 2006)

2.1.4 Lifelong vs. Child Learning

Especially in case of designing a learning environment, it is important to define a target group or better to say, to consider all potential users. Within an open learning environment, e.g. for language learning, it can't be sure, that the users are just children or students. Therefore it is essential to keep in mind, that according to Jackson (1998) and Durham (2010), lifelong or adult learning differs significantly from child learning.

Adult learning strategies differ from child learning, so characteristic attributes are predominant in a particular age group but are not necessarily determined by age groups. The following table describes the most significant characteristics regarding adult learning (androgogy) and children learning (pedagogy). (Jackson, 1998)

Androgogy	**Pedagogy**
voluntary attendance	mandatory attendance
problem centered	subject centered
independent learners	dependent learners
experienced learners	inexperienced learners
learner prescribed content	teacher prescribed content
learners grouped by interests or needs	learners grouped by age level or ability
learning for the now	learning for the future
learners equal to the teacher	learners subordinate to the teacher
flexible, alternative structure	rigid, traditional structure
active learners	passive learners

Table 2.1: Adult vs. Child Learning, Jackson (1998)

When it comes to the importance of purpose in learning, there are differences between adults and children as well.

Within adult learning, learning must have a sense of purpose and give added value to an adult's life, e.g. learning new skills to further career prospects. Adults are more enthusiastic about learning when they can become more actively involved and adults learn better in situations where role playing, group work and discussions are encouraged. (Durham, 2010)

While in children learning, children accept what they are learning, regardless of its purpose. They simply listen to what the teacher has to say and are only encouraged to give an opinion when asked by the teacher. Children need to be able to identify with the teacher as the person who is in sole command in order to be able to learn effectively. Because of the hierarchy within the classroom, children do not always know why they learn, but they assume that it is relevant to their lifes at some stage. (Durham, 2010)

2.2 Language Education

Language learning occurs through social interaction and possessing a language is the quintessentially human trait: all normal humans speak, no non-human animal does. Language is the main vehicle by which we know about other people's thoughts. Constructivism in the process of language learning holds that students no longer accept training passively, but actively process language information and construct language knowledge. The focus is on formation of individual learning and independent learning ability, the leading role of teachers in teaching activities is ignored. (Adair-Hauck et al., 2000; Pinker, 1994; Lei, Meng, & Xiang, 2010)

Wiriyachitra (2003) stated, that the importance of English as a world language, the advance of technology and education reform are determinants for new developments for English language teaching and learning. New technology and the adoption of the Internet have resulted in a major transition in business, education, science and technological progress.

2.2.1 Language Acquisition

Language acquisition is one of the central topics in cognitive science. Language acquisition is a mapping from some input, consisting of speech and other clues from the learning environment, to a grammar that can be used in the generation and interpretation of new utterances (Pinker, 1994; Marcken, 1996). Krashen (1981) mentioned, that language acquisition is very similar to the process children use in acquiring first and second languages. Meaningful interaction in the target language are required, error correction and explicit teaching of rules are not relevant.

Successful acquisition of language typically happens by the age of four, is guaranteed for children up to the age of six, is steadily compromised from then until the puberty and is rare after then. (Pinker, 1994)

First language acquisition: Children almost invariably acquire, in the absence of explicit instruction, one or more languages they are exposed to. (Clark, 2004)

Adult (second) language acquisition: Most adults never master a foreign language, especially the phonology (foreign accent). The individual differences regarding language learning depend on effort, attitudes, amount of exposure, quality of teaching and plain talent. (Pinker, 1994)

2.2.2 Foreign Language Learning

Learning a non-native language in an environment in which there is considerable access to speakers of the target language, can influence the learning success significantly. The quality of the input plays an essential role across different perspectives to second language acquisition. It is not possible to learn a second or any language without sufficient exposure to authentic, diverse, comprehensible and demanding linguistic and cultural materials of the target language. In addition to the qualitative input, language learners need opportunities to practice their exposures, which is beneficial and essential to effective second language learning. Positive feedback help learners to strengthen linguistic knowledge already registered in their inter-language system, whether negative feedback serves as a catalyst for the reconstruction of learners' inter-language grammar. (Clark, 2004; Y. Zhao, 2005)

Individual differences of the learner in terms of language proficiency, cognitive development, learning objectives and learning styles are common and significant factors affecting learner motivation, language intake and task performance. Not all learners have the same linguistic aptitude and also the purpose for learning a second language differs from learner to learner. Some want to understand and experience a foreign language and others want to communicate and conduct business in the target language with its native speakers. (Clark, 2004; Y. Zhao, 2005)

Learners also differ in their learning styles and strategies, have different approaches and strategies to learning grammar, vocabulary and pronunciation. Also reading and listening strategies differ and preferences for communicative settings as well. Learning occurs in different contexts, some prefer learning at home, while others only have access in class. Language learning includes error correction and the presentation of explicit rules and is maintained to help the learner to come to the correct mental representation of the linguistic generalisation. (Krashen, 1981; Y. Zhao, 2005)

2.2.3 Foreign Language Teaching

Foreign language teaching focuses on the process of language acquisition and learning, teaching methodology, autonomous learning, learning strategies and techniques, language awareness, motivation and communicative and intercultural competence. Foreign language teaching is decisively informed by current models of theoretical and applied linguistics, cognitive psychology and pedagogy. The major objective is to offer learners the necessary

knowledge of how to acquire and learn a foreign language. Modern language teaching is learner-centered, which means that native language, personal, social and cultural background and the motivation for learning a language need to be considered. (Mainz, 2011)

2.2.4 English as a Foreign Language and Computer Aided Instruction

English as a Foreign Language (EFL) is the most widely used of all living languages by non-native speakers in the world. It is a challenge to learn and to teach English and vocabulary acquisition is a great hindrance to EFL learners, as it is a lifelong process. English as a Foreign Language Teaching (EFLT) has undergone many reforms in the past periods, from the teacher-centered approach to the modern Computer Aided Instruction (CAI). Compared to English as a mother tongue and second language teaching, EFLT is characterised by a lack of real language environment, the difficulty in organising classroom activity and the limited hours for learning. According to Warschauer and Meskill (2000), CAI can be divided into three stages: behaviourism stage, communicative stage and syntheticism stage fusing with the Internet. CAI is playing a more and more important role in foreign language teaching as current technologies can develop and support powerful CAI systems. (Broughton, 1993; Qiu, 2010)

2.3 Computer Assisted Language Learning

Computer Assisted Language Learning (CALL) is an approach to the process of learning in where technology is used in presenting and implementing the language and its attributes to be learnt. An all-encompassing definition of CALL is hard to find, as the technology, ideas and implementations are changing rapidly. CALL makes use of ICTs in teaching a second language and focuses on receptive skills of reading and listening which are indispensable for learning a language. Some advantages of CALL are the flexibility, individualised instruction, immediate feedback and interactivity. (Tiwari, Khandelwal, & Roy, 2011)

Virtually every type of language teaching has its own technologies, which support them best. Cognitive approaches regarding learning have already been discussed before. Technologies, which support cognitive approaches to language learning, allow learners to expose their language in meaningful context and to construct their individual knowledge. Further technology offers great opportunities for learners and can support teachers in making language learning faster, easier and more engaging. Researchers have concluded, that technology has a great potential to enhance student achievement when used in ways appropriate to developmental levels of the certain learner. But it is up to the teacher to provide guidance and make sure that it is used to meet appropriate instructional goals. (Warschauer & Meskill, 2000; Boss & Van Scoter, 2002)

2.4 Assessment and Feedback

Feedback can enrich students' online learning experience and students' evaluation of their online learning experience can feed back into the ongoing development of an online learning system.(Siragusa, 2006)

Küfi and Özgür (2009) presented arguments underlining the important role teachers play in the successful integration of technology into language teaching. One important question mentioned in this paper is interesting: what do students think about the use of the most recent web-based tools in their language learning experiences?

The results of a survey method to examine the perceptions of students concerning the use of interactive web environment in learning English are presented by Küfi and Özgür (2009). The teachers of the participants created interactive web environments using the web application wiki or moodle. The analysis results implied, that students can be more active in these environments because everything is in their own control. They learn when they want to learn, they choose the activity they like and get the taste of learning from and with their peers and can learn without getting bored.

The study shows, that optimum learning opportunities can be created for language learners through the use of interactive web environments but as previous noted by Kern (2006), teachers have a very significant role to play in such scenarios.

2.5 Conclusion

The literature regarding learning and especially language learning shows, that the whole process of acquiring a language is a complex process which requires caution and time. The forms of learning, which include formal, non-formal, informal, synchronous, asynchronous, supervised, unsupervised, collaborative and cooperative learning need to be taken into account while designing a workable and usable learning environment. As different types of learners are using probably the same learning systems, cognitive, psychological and pedagogical aspects must not be forgotten. Among others, the focus needs to be on flexibility and interaction as an essential ingredient of any learning environment. Technology alone is unable to create an adequate learning environment, therefore pedagogy is integrated with technology.

Traditional learning is teacher-centered, but with the technological support learner-centered theories are gaining more importance. They focus on the needs of the learner and so the learner-centered approach allows students to develop their language and learning skills to become autonomous learners. Not all learners, especially younger ones, are not always able to make their own choices about the learning process. There comes the age factor into account. Another fact that needs to be considered while designing a learning environment is, that adult strategies differ from child learning. Children simply listen to what the teacher has to say and for adults, learning always must have a sense of purpose. Those differences between the age of learners regarding learning and language learning

need to be considered for the design any learning environment.

In second language learning the quality of the input, the opportunity to practice and the quality of the given feedback are playing essential roles in the language learning process. From the teachers point of view, the major objective in language teaching is to offer learners necessary knowledge, which helps to acquire and learn a language. The personal, social and cultural background need to be considered as well during second language teaching. Assessment and feedback play also an important role and within the learning process those terms should not be underestimated. This can keep up the motivation, as for every learner it is indispensable to get feedback for completed learning activities in any way. It is very important to motivate learners and to keep them interested while learning a language, which is a challenge itself.

The following chapter describes the concept of E-Learning in detail. The theory of E-Learning is discussed briefly, then certain strategies, the process itself with according standards and the quality of E-Learning are pointed out. Finally some advantages and disadvantages regarding E-Learning are presented.

Chapter 3

E-Learning

Research in the E-Learning area has increased in the last couples of years due to the recent change of use of the Internet. The great variation in the quality of education is based due to some factors like social background of students, parents, different standards of teacher training programs and all teachers cannot deliver the same message to all learners, which fetches the need of Web based E-Learning. When viewed as a tool for the learner, the computer is used to solve problems of the learner: accessing learning materials, completing homework, or obtaining feedback. Using the tools provided by current technologies, it is possible to turn instruction into a dynamic process where learners are actively engaged in the knowledge construction. (Ray, 2010; Y. Zhao, 2005; Küfi & Özgür, 2009)

3.1 E-Learning in Theory

E-Learning has opened new horizons, where learners can learn independently at any time and from any location, simply by using their computers connected to the Internet along with appropriate systems and tools. The rapid development of and transition to Web 2.0 technologies has resulted in an even greater gap between apparent potential and actual understanding of that potential to influence learning. (El-Sofany, Hasnah, AlJa'am, Ghaleb, & El-Seoud, 2006; Chen et al., 2009)

The components of E-Learning are integral parts of an E-Learning system and features are characteristics of an E-Learning program contributed by those components. Components can contribute to one ore more features, e.g. multimedia (audio, video streaming), communication tools (E-Mail, newsgroup, chat), remote access tools (ftp), Internet navigation tools (browser), GUI, authoring and management programs, LMSs and so on. Features can be interactivity, authenticity, learner-control, ease of use, online support, informal environments, collaborative learning, cross-cultural interaction and so on. (Khan, 2005)

3.1.1 E-Learning Methods

Learners learn in different ways and at different times and therefore it is necessary to support these specific needs for everyone with different E-Learning methods. To fit every learners needs, several E-Learning methods should be combined, so that computer-based learning can take place. It either can be online, blended, synchronous, asynchronous, instructor-led, self-study, computer-based, web-based or video- and audio-based. (C. S. Baker, 2009; Wikipedia, 2011)

In the following listing they are described briefly:

Online Learning is a subset of E-Learning that involves learning that is experienced through the use of computer networks. (Benninck, 2004)

Blended Learning is a combination of online and face-to-face learning, so it combines different types of education techniques and technologies. (Köse, 2010)

Synchronous E-Learning is supported by media like videoconferencing and chat, it is more social and avoids frustration by asking and answering in real time and it helps learners to feel like participants instead of isolates. (Hrastinski, 2008)

Asynchronous E-Learning is facilitated by media like e-mail and discussion boards. So even when learner are not online at the same time, they have the possibility to communicate. That is a key component of flexible E-Learning. (Hrastinski, 2008)

Instructor-led E-Learning is more structured and led through class material by an instructor. It is the delivery of traditional classes in a virtual classroom. (C. S. Baker, 2009)

Self-study E-Learning is basically independent learning, which gives the learner the freedom and flexibility to learn where and when the learner wants to, but a certain amount of self discipline is necessary. (C. S. Baker, 2009)

Computer-Based Training are self-paced learning activities via the computer. (Wikipedia, 2011)

Web-Based Training is training delivered via the Internet using a Web browser. (Wikipedia, 2011)

Video- and audio-based E-Learning defines an interactive communication medium. Video and audio as well stimulate better brainstorming, knowledge sharing and the gathering of information. Regarding video-based E-Learning, the visual connection and interaction among participants can enhance understanding and helps participants to feel connected to each other. Further it can be a great way of demonstrating and guiding step by step. (Grover, 2007)

3.1.2 E-Learning Objects and the E-Learning Process

Learning objects are key definitions to understand an E-Learning system structure as well as the core of re-usability, interoperability and adaptability. Learning objects are chunks of data that are authored, stored, indexed, assembled, delivered and evaluated by

E-Learning systems. They can be developed easily and stored in repositories. A successful design should always have the re-usability in mind. The additional effort to work with a framework significantly increases the interaction between students and enriches the educational environment. Interaction is an essential ingredient in any learning process. (Varlamis et al., 2006; Pickman & Liu, 2009; Woo & Reeves, 2007)

To answer the question what more can technology innovations do to make their application mainstream in E-Learning, Kumar (2008) introduced a 'critical mass' measure for each recognised educational technology and stated 'share-ability' as a key measure for critical mass. Share-ability includes the use of a tool, trace data that could potentially be collected by the tool, like a learning object, and how semantically transparent this data could be for other tools. In case of research data, critical mass corresponds to share-ability of trace data obtained from learning objects. Within skills of learners, critical mass corresponds to share-ability of depth of skills of learners across multiple learning objects and in case of motivation and incentives, critical mass corresponds to share-ability of interplay between motivation and incentives. The use of a critical mass measure can be used to indicate how generalisable and widely applicable a particular educational technology is and factors like 'share-ability', 'learner traits' and 'motivation & incentives' could contribute to the critical mass measure. (Kumar, 2008)

An E-Learning process comprises conceptual and physical components and procedures that should be standardised in terms of procedures and technologies. The issues that must be well defined concerning the conceptual background of an E-Learning application are the design of the E-Learning process, the definition of learners' competences and the framework for the co-operation among teachers and educates. The physical components comprise the learning content and its packaging and deployment, the learners' profile, the assessment activities, the metadata structure and the system architecture. The life cycle of an E-Learning process, as illustrated in figure 3.1, comprises of four phases: the design phase (specify targets and requirements), the production phase (produce, assemble and package content for distribution), the deployment phase (collaboration of learners in order to distribute the appropriate content per case) and the assessment phase (evaluate the outcome of the whole process). (Varlamis et al., 2006)

For a successful design of a learning process the required features of learners' profile and the recommended competencies should be defined and the educational targets to be achieved by the end of the learning process should be specified. The production phase that follows integrates the production of content modules, their build up based on the initial design and the packaging of the content to be delivered. The deployment phases should consider the ability of users to access the content and collaborate during the learning process, which ends with the assessment of learners through tests and other activities. Useful information is collected at the end of every phase and acts as a feedback to every previous phase of the E-Learning process, which facilitates the improvement of the whole process and leads to better solutions for learners and educators. (Varlamis et al., 2006)

Varlamis et al. (2006) described the issues of interoperability and standardisation of tasks within the learning process and mentioned that during the whole life cycle, from the design of a course to the final assessment, there is a strong influence between tasks. The learn-

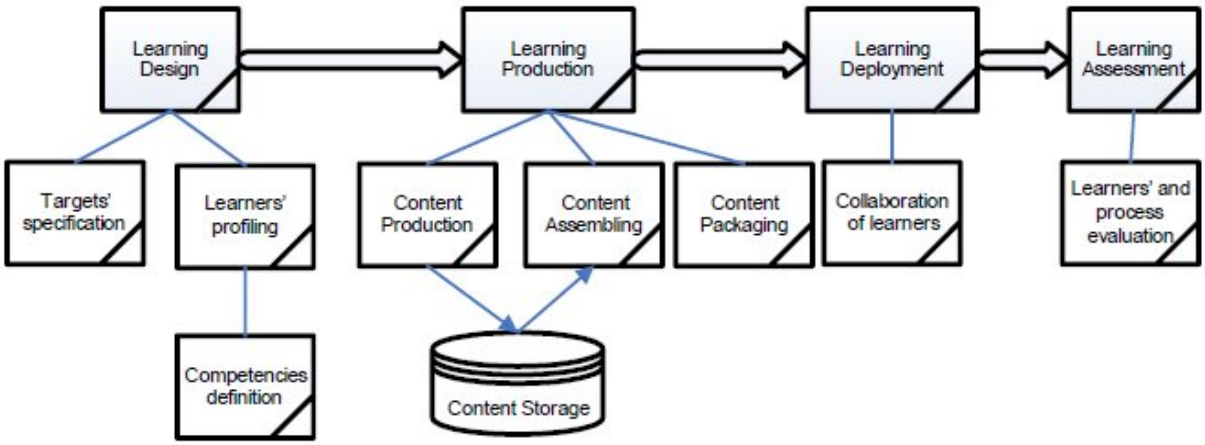


Figure 3.1: The life cycle of an E-Learning process (Varlamis et al., 2006)

ers profile is strongly related to the competencies required by the learning process and the educational targets. The interoperability of tasks should be built on well tested and widely adopted standards, which enable teachers and learners to better understand each other. Systems that produce, process and distribute learning content must cooperate and exchange information based on standards. Systems developed by many vendors without following any standards will lead to the fragmentation of incompatible technologies and results in a system that cannot cooperate and content that cannot be reused. Standards impose requirements on how to create content or on how to define a procedure or a user profile. All technical issues should be first resolved to minimise development and deployment costs, to facilitate re-usability of content and increase effectiveness of the learning process to achieve interoperability of technologies and systems. This can be performed in the basis of common standards which allows to focus on the educational aspects of learning.

The Web-based information system is the most suitable for managing E-Learning processes, on which the platforms are independent and the learning object delivery is carried out through the Internet (Zheng-wang et al., 2008). E-Learning has a well developed approach to the creation and sequencing of content-based, single learner, self-placed earning objects, which are elementary particles of an E-Learning system. (Dalziel, 2003; Wiley, 2001)

3.1.3 E-Learning Standards

Pioneers of the E-Learning community cooperated to define standards, recommended guidelines, protocols and architectures for the development of E-Learning content, services and products. Those pioneers collected user requirements, issue specifications for E-Learning systems, development and test applications, which validate the user requirements and convert the approved specifications into standards. Developers, vendors and users of E-Learning systems develop, support and adopt standards for the overall learn-

ing process. The adoption of standards and specifications facilitates the dominance of platform independent, open technologies and promotes user-centric e-learning systems. (Varlamis et al., 2006)

Varlamis et al. (2006) defined steps for establishing E-Learning standards, see figure 3.2, and presented some key goals, achieved by the definition and adoption of E-Learning standards:

- Users of E-Learning applications will be able to shift between programs and platforms, because the learners gain in flexibility since the attained knowledge can easily migrate to future e-learning platforms that follow the same standards.
- Learning content producers focus on development of content in a standard format instead of many formats for different platforms and applications.
- Tool vendors develop less expensive tools of better quality and subsequently increase in the size of the potential market.
- Application and platform designers are able to reuse content, systems and tools and assembled a competitive and effective E-Learning platform and they can populate the existing storehouse with new modules of content and applications.

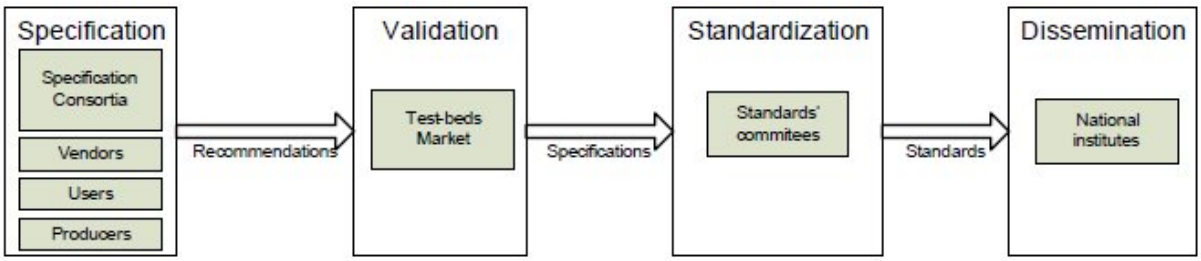


Figure 3.2: Steps for establishing E-Learning standards (Varlamis et al., 2006)

Varlamis et al. (2006) stated, that standardised technologies in E-Learning can be achieved through the cooperation of all participants of the E-Learning community. Developers, vendors and users at this standardisation of procedures have several merits that protect and nurture an E-Learning investment as follows:

- Interoperability: Content for multiple providers can be easily disseminated and problems of translation, communication and information exchange are easily solved.
- Re-usability: Content and code can be assembled, disassembled and re-used quickly and easily and additionally content objects can be adapted and used in a context other than the original purpose.
- Manageability: The system can track the appropriate information about the learner and the content and learners' profiles, educational target and content is easier to find, manage and to assemble.
- Accessibility: A learner can access the appropriate content at the appropriate time on the appropriate device.

- Durability: Content is produced once and transplanted many times in different platforms and systems.
- Scalability: Learning technologies can be expanded in functionality to serve broader populations and organisational purposes.

Numerous organisations and consortia are working in the area of E-Learning standards. To give a few examples, the Dublin Core Metadata Initiative[1], the IEEE[2], the Instructional Management System (IMS) Global Learning Consortium [3], Alliance of Remote Instructional Authoring and Distribution Networks for Europe (ARIADNE) [4], CEN/ISS Workshop on Learning Technoligy[5], Aviation Industry CBT Committee[6] and HR-XML Consortium[7].

To give an example, the *IMS Learning Design* specification supports the representation of dynamic behaviour on behalf of the system and this standard is an appropriate vehicle for introducing adaptive capabilities in non-adaptive E-Learning systems. (Paramythis & Loidl-Reisinger, 2004)

3.1.4 Quality of E-Learning

Quality can be perceived as added value, satisfaction or positive transformation. The derivative quality assurance is the part of quality management focused on providing the confidence that quality requirements are being fulfilled. Quality is a core value of every E-Learning system and the quality assurance needs to be perceived as a dynamic, iterative and ongoing process and can be embedded into daily practices within the E-Learning experience. (Abdous, 2009)

A process-oriented life cycle model for implementing quality assurance in E-Learning provided by Abdous (2009) is illustrated in figure 3.3. The design, production and delivery of E-Learning requires a streamlined workflow and the collaboration of several specialists regarding subject, instruction and technique. This model mirrors a framework for planning, designing, producing and delivering E-Learning courses and is structured around three sequential non-linear phases:

- before: planning and analysis
- during: design, prototype and production
- after: post-production and delivery

[1] `http://dublincore.org/`
[2] `http://www.ieee.org/`
[3] `http://www.imsglobal.org/`
[4] `http://www.ariadne.eu/`
[5] `http://www.cen.eu/`
[6] `http://www.aicc.org/`
[7] `http://www.hr-xml.org/`

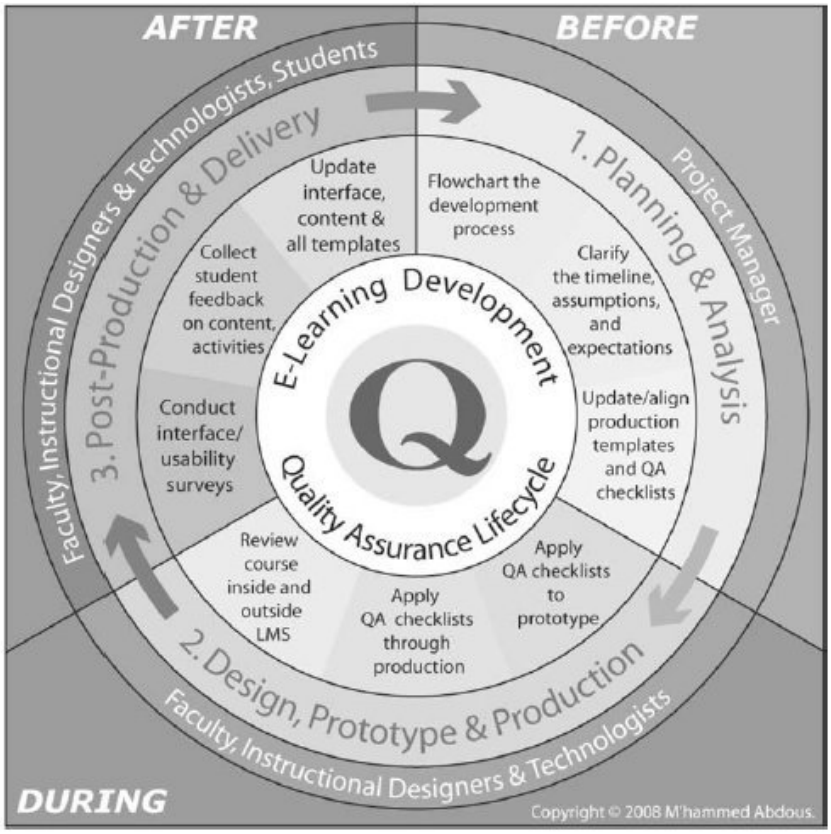


Figure 3.3: Process-oriented life cycle model for QA in E-Learning (Abdous, 2009)

In the planning and analysis phase, the project plan is used as a quality assurance tool to flowchart the development process and to clarify timeline, assumptions and expectations. During design and production, pre-designed content collection templates are used to ensure appropriateness, comprehensiveness and consistency of content. In the post-production phase, surveys regarding the E-Learning courses, interface usability and student feedback are collected and administered. This model parallels the course development process and is aimed both at moving quality from a static, after-the-fact state to a more iterative and dynamic state. (Abdous, 2009)

3.2 Characterising Needs of an E-Learning Environment

During the planning and design phase of an E-Learning environment it is necessary to note some characteristics of certain E-Learning platforms.

Reeves, Herrington, and Oliver (2002) identified guidelines for educational applications of authentic activities within online learning environments and pointed out some characteristics (as cited in Woo & Reeves, 2007). Authentic activities have real-world relevance, are ill-defined, requiring students to define the tasks and sub-tasks needed to complete the activity and comprise complex tasks to be investigated by students over a sustained

period of time. Further they provide the opportunity for students to examine the task from different perspectives, the opportunity to collaborate and the opportunity to reflect. Authentic activities can be integrated and applied across different subject areas and lead beyond domain-specific outcomes, they are seamlessly integrated with assessment, they create polished products valuable in their own right and allow competing solutions and diversity of outcomes. (Reeves et al., 2002)

Chang and Gütl (2008, p. 2) discussed the characteristics of E-Learning 2.0, which is a people-centric approach, includes blurring roles of teachers and studends, the collaborative nature of learning, transfer of pre-existing knowledge, strong focus on content sharing, reuse and re-purposing and personalisation. Further the most important dimensions of an E-Learning environment were presented, which need to be considered as the learning content, the learning process, the learning community, the organisational aspects and the technological aspects. Moreover the high complexity of the environmental conditions, the need for collaboration and competition and the changing relations between members of the learning community, sources and services must be considered. (Chang & Gütl, 2008)

As often stated in the investigated literature, E-Learning should be low-cost, the attention of the user needs to be attracted, social aspects need to be considered and interactivity is one of the main keys to a successful platform. Special needs in relation to cross-nations, cross-cultural and distance learning must not be forgotten. To keep all those aspects in mind while developing an E-Learning platform does not guarantee success, but the following subsections cover the minimum needs of every potential E-Learning user.

Attract Users' Attention

The rapid deployment of Web 2.0 tools in higher education begs research to the benefits for students in E-Learning (Meyer, 2010). Attention is a scarce resource and with the super-abundance of information available online, it is attention which is the basic currency of the Internet and the experience of information overload is more appropriately understood as an overload of attention-grabbing opportunities. If an user is regularly attracted to contribute to a website, the user-generated content is successful. (Mason & Rennie, 2007)

Mason and Rennie (2007) stated some benefits of user-generated content:

- Users have the tools to actively engage in the construction of their experience.
- Content will be continually refreshed by the users.
- Many tools support collaborative work and they allow users to develop the skills of working in teams.
- Shared community spaces and inter-group communications are a massive part of what excites young people and contribute to users' persistence and motivation to learn.

Support Social Networks and Interactivity

Offer a system that is compatible with existing social systems and semantic Web technologies is ease of access and immediate value to user within a web-based environment that has the sophistication and look and feel of an application environment. (Richards, 2009)

John and Melster (2004) (as cited in Richards, 2009) presented the Software Engineering Body of Knowledge (SWEBOK) project and found that in order to support social networks of people to collaboratively engineer a knowledge base it is necessary to. Further Richards (2009) completed these with additional needs:

- Build a shared repository which achieves a common understanding and structure with means of finding out what projects or problems people are working on and provide opportunities for sharing and reuse.
- Allow people to create content using their own terms and concepts.
- Develop a top-down knowledge map in form of an ontology or concept map to assist people to define and structure their own concepts.
- Allow the knowledge nuggets to emerge bottom-up or tow-down where appropriate.
- Support a range of expertise levels, views of knowledge and access rights.
- Provide a review process in which users can register their agreement or disagreement.
- Test and keep track of consistency between all elements of the knowledge system.
- Be compatible with a wide range of existing systems.
- Provide an intuitive, simple and structured knowledge maintenance cycle.

Interactive learning stimulates the interest of learners and enhance learning effects. Learners can teach themselves and each others without time and space restriction. Knowledge can be constructed by learners while collaborating and having conversations. (Lei et al., 2010)

Low-Cost Learning

To provide scalability, the distribution of material to the student must be provided in a cheap way. Streaming audio and video on the one hand can make the online course more interesting, on the other hand possible technical barriers needs to be considered. Such technical barriers would be connectivity speed, web page response times and re-purposed training materials. A common educational framework is a low cost and flexible software suite of integrated open source applications. (Pickman & Liu, 2009; Natarajan, 2004; Gehne et al., 2001)

To give an example, a low cost mobile node network simulator is a simple example of a Common Educational Framework (CEF) and could be an integrated multi-computer

simulator which would provide many areas of learning and exploration and would be a good common platform. A simulator has specific areas that can be explored and it could be expanded and adapted to meet the needs of a number of different and adjacent disciplines. (Pickman & Liu, 2009)

Distance Education

The rapid growth of the Internet and digital technologies made the web a powerful, global, interactive, dynamic, economic, and democratic medium of distance learning and distance teaching. Interaction within distance education is based on a sender-receiver-framework and learner-content, learner-instructor and learner-learner interaction (Khan, 2005; Moore, 1989). Web-based E-Learning is the one and only simple solution to provide an equal quality of education to all students (Ray, 2010). In distance education many different dimensions like student, teacher, media, technology access, cost, resources, social dimensions etc. must be taken into consideration. (Usluel & Mazman, 2009)

Cross-nations and Cross-cultures E-Learning

When designing E-Learning environments for cross-cultural collaborative online learning it needs to be considered, that when learning communities transcend nations and cultures, the learners' cultural perceptions and experiences influence their online collaboration and communication behaviour. (Chen et al., 2009; Paramythis & Loidl-Reisinger, 2004)

3.3 Advantages and Disadvantages of E-Learning

E-Learning is affordable, saves time, produces measurable results and it can be done in any geographic location. E-Learning is beneficial to education, corporations and to all types of learners and flexibility is the major benefit of it, because E-Education (EEDU) is available when and where it is needed. Students have the advantage of learning at their own pace and it accommodates different types of learning styles. E-Learning allows students to select learning materials that meet their level of knowledge and interests and it is more focused on the learner and more interesting for the learner. Because of its flexibility it can be customised to meed the individuals needs of the learners and E-Learning encourages students to take personal responsibility for their own learning. (Ray, 2010)

One big disadvantage of E-Learning is that learners need to have access to a computer or mobile device as well as the Internet and therefore they also need to have computer skills. Without skills and software it is not possible for the student to succeed in E-Learning and also slow Internet connections or older computers may make accessing course materials difficult. Also the management of computer files and online learning software can be a disadvantage, because for learners with beginner-level computer skills it can be complex to keep their computer files organised. Learners may lose or misplace reports causing

them to be late in submitting assignments and this all may cause the learners to get frustrated. Students have to be highly motivated and responsible because all the work they do is on their own and learners with low motivation or bad study habits may fall behind. E-Learning students can feel isolated from the instructor, because they are not always available to help, so learners need to have discipline to work independently without the instructor's assistance. (Ray, 2010)

3.4 Conclusion

E-Learning needs to be and also is in most cases affordable, flexible, a benefit for the learner and available from anywhere. Learning is a social process, which involves acquisition of knowledge and interaction. The key to successful learning is interaction. E-Learning has a variety of learning methods and not every method is suitable for every learner. Therefore an E-Learning environment needs to support more than one E-Learning method, such as blended, instructor-led or self-directed. An E-Learning system needs to be flexible enough, to keep with the rapid development of Web 2.0 technologies. Some current standards should be kept in mind, while designing an E-Learning environment: interoperability, re-usability, manageability, accessibility, durability and scalability of the E-Learning environment. Quality is another important part, so a quality assurance within the learning environment needs to be handled as a dynamic, interactive and ongoing process.

Disadvantages of E-Learning, like the level of experience with computers, the isolation factor and the discipline of the learner must be taken particularly in consideration while designing an E-Learning environment. On the other hand benefits like non-stop accessibility, the flexibility and convenience make E-Learning more and more interesting and are key factors for its fast growing.

The next chapter handles the huge topic E-Learning. Current trends in this area are presented, characterising needs for an E-Learning environment are collected and some concepts and theoretical frameworks are introduced. Further some E-Learning systems which are in use are summarised. Finally related work, which concludes some existing E-Learning environments for language learning are illustrated.

Chapter 4

E-Learning and Knowledge Transfer

An E-Learning platform consists of online learning, web-based training, virtual universities and classrooms, digital collaboration and technology assisted distance learning and is mainly depending on different kind of users and their requirements. In order to achieve optimal efficiency in a learning process, individual learners cognitive learning style should be taken into account. (Ge & Chao, 2005; Guo, 2008)

The goal of a common educational framework is to rapidly highlight and identify educational gaps and help filling those gaps. There is demand for affordable, efficient, easily accessible, open, flexible, learner-centered learning environments and the learning environment needs to be flexible enough to enable students access to all relevant resources. (Caine & Caine, 1991; Khan, 2005; Chang & Gütl, 2008)

An E-Learning application must be easy to use and compliance with current standards in web application developments. A web application must have a pleasant, practical, look-and-feel design for its user interface and needs to allow users to intervene at content level. The web application must have a unique, coherent interface, even if it uses many different technologies. All the learning components and applications are clearly defined, effectively discovered and loosely coupled. If content is created by users on different systems then it is difficult to keep track of changes. Therefore this should be avoided. (Kristaly et al., 2008; Zhen, 2009; Mason & Rennie, 2007)

After the introduction to the terms learning, language learning and all related concepts and principles, this chapter focus on the E-Learning technologies and which can be used and derived for the E-Learning prototype. Needs and key characteristics for meaningful E-learning environments are uncovered and researched from existing online language learning environments. This chapter builds the basis for the definition of the requirements and further the design concept of the language learning prototype.

4.1 Trends in E-Learning Technologies

A knowledge of English is essential for success and prosperity in technical nations, but also to nations which struggle to meet demands of the global economy. EFL is the most widely used language in the world. There are three major components of every language: phonetics, grammar and vocabulary, where vocabulary is the carrier of the remaining two components. A large collection of words is essential to language proficiency and skills like listening, speaking, writing and reading. The Internet and web 2.0 technologies bring up a way of collaborative learning by dividing and distributing effort and sharing knowledge among EFL-learners. (W. Zhang & Qiu, 2011)

The Internet supports open learning because it is device, platform, time and place independent. Openness is a technical matter, flexibility is a design matter. The Internet is well-suited for open, flexible and distributed learning, as visualised in figure 4.1. Success in an E-Learning system involves a systematic process of planning, designing, evaluating and implementing online environments. In those learning environments learning needs to be actively fostered and supported and the system should be meaningful for learners, instructors and support services staff. (Khan, 2005)

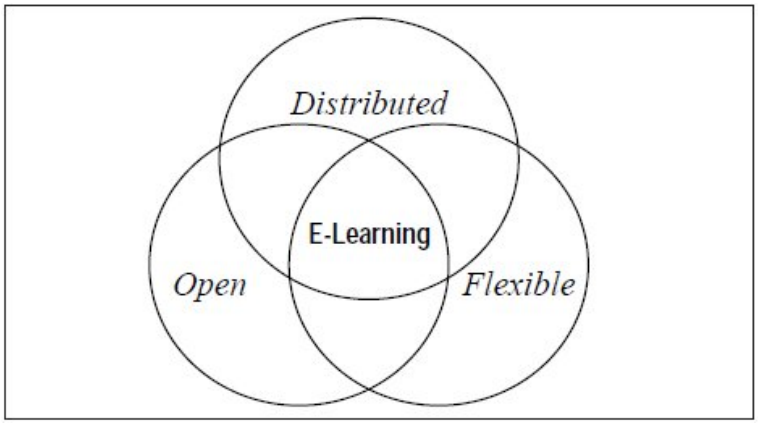


Figure 4.1: Open, flexible and distributed E-Learning (Khan, 2005)

Zhen (2009) mentioned the key characteristics of an ideal E-Learning system:

- Personalisation, which means the ability to serve dynamic response to the user based on personal profiles.
- Collaboration, which includes tools that allow e-mail, team rooms, shared places etc.
- Source sharing, which facilitates sharing learning resources as well as the management of content.

It is necessary to provide a flexible integration model to achieve the emerging needs of the novel collaborative E-Learning system. It is useful to provide a comprehensive platform

in which all the collaborative learning components are published, described, located and invoked in a standard way. (Zhen, 2009)

In the following subsections selected tools, standards and frameworks are presented. The reason therefore is, to give an overview about current standard and used technologies within the E-Learning area.

4.1.1 Internet Communication Tools

Internet communication tools allow learners to exchange information, contribute to discussions and provide opportunities for learners to acquire alternative perspectives easily. Learners can communicate interactively one to one or in groups. Internet communication tools are e.g. e-mail (one-to-one messaging), list services (one-to-many messaging), Bulletin Board System (BBS) (leave message on bulletin board) and chat (real time communication).

Online communication is either synchronous or asynchronous.

Synchronous communication is in real time, which means the possibility of immediate response, and requires the participants to be online at the same time. Some disadvantages of real time synchronous communication are the limited time for thinking, the different time zones could limit the access, low-bandwidth could limit the access and typing skills and typing speed limit the contribution. (Ashley, 2003)

Asynchronous communication is non-real time and it does not require, that the participants are online at the same time. The advantages of this type of communication are, that there is enough time to make a considered response and the messages can be accessed at a suitable time. A problem can be, that without any time constraints, responses could take very long and the loss of human contact also needs to be considered. (Ashley, 2003)

4.1.2 Content and Learning Management Systems

The Web has become a platform for groups of web users to socialise, collaborate, and work with each other through adoption of Web 2.0 social software that allows flexibility in data sharing. (Al-Senaidi, 2008)

Content management systems are systems or processes in place to manage the content of a website in a cost effective way. The size of an organisation and the geographic dispersion of the users must be taken into account for deciding for a CMS. With a CMS a web site can be updated easily and quicker and there is no need to comprise the consistency of the design of the website. (Wikipedia, 2011)

Learning management systems are intended to manage the learning environment and synchronise production and dissemination tasks. It manages the processes surrounding learning (Varlamis et al., 2006). LMSs are available to implement web-based learning environments and LMS packages focus on pushing content to a student and managing the flow

of a course. A LMS tracks and reports a students' progress and interactions between the instructor and tutor. (D. A. Baker & Rees, 2008)

Learning content management systems are multi-user environments where learning developers can create, store, reuse, manage and deliver digital learning content. It manages the process of creating and delivering learning content including content authoring and assembly, registration, storage and retrieval of objects based on standards. (Varlamis et al., 2006)

An E-learning system in general consists of people, an authoring system, a run-time system and an LMS as visualised in figure 4.2. (Huang, 2009)

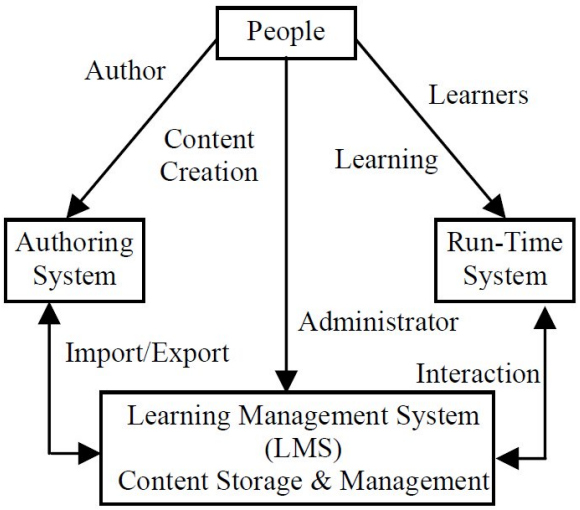


Figure 4.2: Generic view of LMSs (Huang, 2009)

Some selected Frameworks

To give an idea, which existing frameworks are already in use with a lot of learning and teaching environments, some selected frameworks are listed below.

Joomla[1] is a free, open-source CMS and an application framework with a vibrant volunteer community and user-friendly features. Joomla is based on Hypertext Preprocessor (PHP) and MySQL under the GNU General Public License. (Joomla, 2011)

Drupal[2] is an open source content management platform and it is free, flexible, robust and constantly being improved. Drupal provide a lot of content management features and is distributed under the terms of the GNU General Public License. (Drupal, 2011)

TYPO3[3] is a free open source CMS and is based on PHP and MySQL under the GNU General Public License. TYPO3 is database-driven and offers full flexibility and extend-

[1] http://www.joomla.org/
[2] http://drupal.org/
[3] http://typo3.com/

ability while featuring an accomplished set of ready-made interface, functions and modules. (TYPO3, 2011)

Butterfly is a web-oriented CMS which offers a framework for complex Web applications and provides a of lot features like easy to use, error-proof and error-save, authentication mechanism for security and it's eXtensible HyperText Markup Language (XHTML) compatible. Butterfly CMS consists of two sections, the frontend, designed for the users, and the backend, used only by administrators and editors. The frontend's look-and-feel is controlled by a configurable XHTML template. The backend access is granted after authentication based on username and password. Content elements can be any type of HyperText Markup Language (HTML) elements like formatted text, tables, images, java applet or flash movie and each is managed by one content extension.

An extension registry, which is a table in the database, keeps track of installed extensions. As depicted in figure 4.3, the CMS is organised as a three layered application with a server, a client and a data layer. The server side uses the PHP script language, running on an Apache web server, to generate the (D)HTML content which is sent to the client. The client is a web browser and (D)HTML and JavaScript is used and the style is controlled by Cascading Style Sheet (CSS) files. The data layer is composed of Extensible Markup Language (XML) files and one relational database, with MySQL as Database Management System (DBMS). The Asynchronous JavaScript Technology and XML (AJAX) technique is used for the HyperText Transfer Protocol (HTTP) requests using the XMLHttpRequest object form the JavaScript code. (Kristaly et al., 2008)

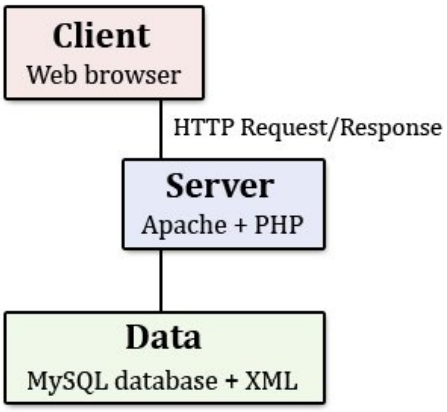


Figure 4.3: The layers of the Butterfly CMS (Kristaly et al., 2008)

4.1.3 Portal Software

A portal provides a single point of entry to widely distributed information on the web and it offers a unified way to access information. Portals provide an easy way to configure desired content on a personal web page and a consistent look and feel. Users can use many applications in the same manner and can access information from various sources. The content within a portal generated by web applications can be static or dynamic. A

portal is single sign-on, which means that once the portal authenticates the user, it applies the same credentials to all applications displayed on the portal pages. A portal provides personalisation, where a user, or the portal designer, can decide what applications should be initially displayed on the personal portal page. Further portals provide collaboration among their users, as most of the Web 2.0 features like wikis, blogs and social networking are available. Wikipedia classified portals into categories based on the use of each type: personal portals, academic portals, regional web portals, government web portals, corporate web portals, domain-specific portals and sport portals. (Sarang, 2009; Wikipedia, 2011)

Personal portals can be customised by an individual, to meet the requirements and taste of the certain user. Those kind of portals are easily customisable and the customisation information is stored in the individual's user account. To give some examples, iGoogle[4] and My Yahoo![5] provide customisable portal sites. (Sarang, 2009)

Academic portals address the needs of academicians. To give an example, uPortal[6] is a typical academic sharable portal under development and provides a platform for collaboration. To give another example, the Austrian Academic Portal[7] is a straightforward portal site and a gateway to Austrian institutions that teach science and humanities, research, education and culture.(Sarang, 2009)

Regional web portals provide information, like weather forecasts, street maps or local news, to a specific geographic location. An example for such a regional portal is China's SINA[8] which offers information about business, sports, lifestyle and entertainment in Chinese and English.(Sarang, 2009)

Government web portals provide information for citizens, presented by governments. To mention an example, the USA.gov[9] provides information for citizens, businesses and not-for-profit organisations, government employees and visitors. (Sarang, 2009)

Corporate web portals are intranet portals, a standard among corporations, and provide a consolidated view of the company's information to its employees and often allow employees to personalise and customise the site's content. (Sarang, 2009)

Domain-specific portals are portals geared toward a particular industry. (Sarang, 2009)

Sports portals try to satisfy the needs of sports lovers. (Sarang, 2009)

Liferay Portal provides a framework for creating any of these types of portals.

[4] http://www.google.com/ig
[5] http://my.yahoo.com/
[6] http://www.uportal.org/
[7] http://www.portal.ac.at/index-en.html
[8] http://www.sina.com
[9] http://www.usa.gov

4.1.4 Web 2.0 and the Semantic Web

Web 2.0 applications use the Web as a platform, are flexible, have information that users are looking for and are easy to use. Web 2.0 applications allow users to share videos and links, find and stay in contact with friends, comment on each other's photos, and much more. Web 2.0 services use the web as a platform simply replacing the desktop with the web browser. The Semantic Web or sometimes also called Web 3.0 is about making the Web more understandable by machines by explicitly declaring the knowledge embedded in many web-based applications and integrating information in an intelligent way. (D. A. Baker & Rees, 2008; Click & Petit, 2010; Ghaleb, Daoud, Hasna, Jaam, & El-Sofany, 2006)

To give a brief introduction into the essential area Web 2.0, Web 2.0 technologies, like blogs, tagging and mashups, are described in the following subsections.

Web 2.0

There is not one word to describe the term Web 2.0, even figure 4.4 covers just a fraction of what Web 2.0 is or is meant to be.

Figure 4.4: The huge cloud lens bubble map web 2.0 (Angermeier, 2005)

Social networking is the building of online communities and online social networking services provide a variety of ways for members to interact - from emailing to instant messaging to photo tagging (Click & Petit, 2010). Zyl (2009) stated that an individuals' success in

society depends on the shape and size of his social network. The ability to network and form connections with other social groups is important as well, because social networking applications support the maintenance of personal relationships. Social Networking 2.0 applications should create and manage a digital expression of people's personal relationships or links. This is realised with automatic address book updates and viewable profiles.

Mason and Rennie (2007) mentioned, that with Web 2.0 the popularity of social networking sites has changed and three defining characteristics were stated:

- Profiles, have unique URLs and include an identifiable handle, information about the user (e.g. age, location, interests), eventually a photograph and information about last login.
- Traversable, publicly articulated social network, list other profiles as 'friends or contacts'. The result is a social network graph which may be directed or undirected and each node contains a link to the profile of an other person. Individuals can traverse the network through friends of friends of friends.
- Semi-persistent public comments, like testimonials and guest book messages can be left by participants on an others profile.

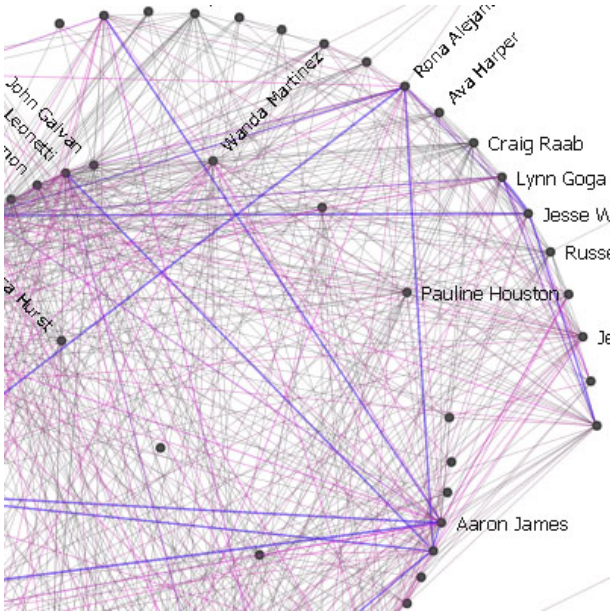


Figure 4.5: Facebook social network graph (Infosthetics, 2008)

To give some examples, social networking sites are Facebook[10], MySpace[11], Twitter[12] or Tagged[13]. In figure 4.5 an interactive network of Facebook is visualised, which highlights commonalities between common friends.

[10] http://www.facebook.com/
[11] http://www.myspace.com/
[12] http://twitter.com/
[13] http://www.tagged.com/

Social bookmarking websites like Delicious[14], makes the list of an user's bookmarks available anywhere the user is connected to the Internet and users are able to store, organise, search, manage, and share web-page bookmarks. (Wikipedia, 2011)

Tagging is the use of key words to track content on Websites and can be used as a form of social bookmarking. A user can gain access to all the content identified by other users and linked to the specific key word (Zyl, 2009). To give some examples, tagging is used with del.icio.us and flickr[15].

The pioneer of Wikis is Wikipedia[16] and according to Wikipedia (2011), *"A wiki is a page or collection of Webpages designed to enable anyone who accesses it to contribute or modify content. Wikis are often used to create collaborative websites and to power community websites."* (as cited in Click & Petit, 2010)

Blogs are a part of the Web 2.0 landscape and have the purpose to present news, events, and other information. The most popular blogs tend to embody the concept of Web 2.0 because the blogger writes and publishes an entry, and readers respond in the blog's comments or in their own blogs. The blogger can react to comments in the comments or in a new blog entry. Blogs can host extensive conversations between people who may not know each other in real life (Click & Petit, 2010). To mention some examples, free available Web-blog publishing tools are Blogger[17] and Wordpress[18].

Really Simple Syndication (RSS) helps various social media to interact with each other. It can be used e.g. to track student blogs, as well as library and technology blogs. RSS greatly facilitates almost every Web 2.0 technology and is an excellent tool for filtering and keeping up with information. (Click & Petit, 2010)

A forum is a discussion site in the Internet where conversations can be hold in form of postings on a message board. To name a few examples, phpBB[19], Vanilla[20] and YetAnotherForum.NET[21] are open source forums. (Wikipedia, 2011)

Video and photo sharing are important aspects of Web 2.0 and almost everyone with Internet access is familiar with YouTube[22], Flickr[23] and similar sites. People use them to watch TV, commercials and home made videos and plenty of them have never ever load a video to the website or even created an account. Just some people load their own videos to share. YouTube can also be a part of information literacy programming just by loading tutorials onto it or use videos to teach difficult concepts. (Click & Petit, 2010)

Content sharing applications in the Web 2.0 are peer-to-peer and allow user easily to share multimedia contents. YouTube, Facebook and MySpace are just some few representative

[14] http://www.delicious.com/
[15] http://www.flickr.com/
[16] http://en.wikipedia.org/
[17] www.blogger.com/
[18] wordpress.com/
[19] http://www.phpbb.com/
[20] http://vanillaforums.org/
[21] http://yetanotherforum.net/
[22] http://www.youtube.com/
[23] http://www.flickr.com/

exemplars which allows to publish images and videos on personal blogs and virtual spaces. One of the main characteristics of these applications are concerned with the possibility for the user, to freely define and associate tags to the uploaded contents, which helps to search and discover new contents (Ferretti, Mirri, Muratori, Roccetti, & Salomoni, 2008). Free peer-to-peer based sharing applications are per example BitTorrent[24], Shareaza[25] and eMule[26].

Collaborative real time editors are text editors that allow simultaneous editing of the same text by different participants using different computers. Web browser based collaborative real time editing of documents are most used as web-based applications and real time source code editors (wikia, 2011). A huge variety of software for collaborative real time editing of text exists and most of them are platform-independent and open source. They are free and easy to use and support syntax highlighting and operate through a web browser as listed at wikia (2011) AMY[27], ACE (editor)[28], Gobby[29] and MoonEdit[30]. To give some examples for web browser based collaborative real time editing, *Google Sites* [31], SynchroEdit [32], Collabedit[33], Squad[34], beWeeVee[35]. Other software that allows collaborative real time editing are GNU Emacs[36], Gnu Screen[37] and DocSynch[38]. Collaborative but not real time software is Writeboard[39], Writely[40] and OpenEffort.com[41].

Computer aided feedback & assessment systems are systems which are using information technologies to improve feedback and assessment methodologies for providing efficiently, effectively and consistently feedback and assessment information to students (Freney & Wood, 2006). CAFAS online[42] is a web-based system for designing feedback forms. Some examples for Computer Aides Assessment (CAA) tools are Hot Potatoes[43], Questionmark[44], Homeroom[45] and Eduware[46].

[24] http://www.bittorrent.com/
[25] http://shareaza.sourceforge.net/
[26] http://www.emule-project.net/
[27] http://www.amyeditor.com/
[28] http://sourceforge.net/projects/ace/
[29] http://gobby.0x539.de/trac/
[30] http://moonedit.com/index.html
[31] http://sites.google.com
[32] http://synchroedit.com/index.php
[33] http://collabedit.com/
[34] https://squadedit.com/
[35] http://www.beweevee.com/
[36] http://www.gnu.org/software/emacs/
[37] http://www.gnu.org/software/screen/
[38] http://docsynch.sourceforge.net/
[39] http://writeboard.com/
[40] http://docs.google.com
[41] http://www.openeffort.com/
[42] http://cafas.pbworks.com/
[43] http://web.uvic.ca/hrd/halfbaked/
[44] http://www.questionmark.com/
[45] http://www.homeroom.com/
[46] http://www.eduware.com/

Electronic performance support systems are computer-based environments that facilitate skills and knowledge acquisition within a particular domain of study. It is a pedagogic utility and can also be used to augment and enhance an individual's performance. (P. Van Schaik & Barker, 2002)

Mashups, according to D. A. Baker and Rees (2008), are a combination of services into a new service and part of mashups are web services, which provides the data for the mashups to utilise. Mashing up compound multimedia with arising technologies and trends on the Web 2.0 goes beyond the state of the art. Existing services can be 'mashed up' for a different final product and the idea is that it fits into the rapid development model. (D. A. Baker & Rees, 2008; Ferretti et al., 2008)

The design of a mashup should follow 5 steps:

1. Determine a rough idea about the look and functions of the new system.
2. Select services which together would be close to the needed functionality.
3. Mashup the services into a rough service-prototype.
4. Deploy and get feedback of the users.
5. Review how the feedback relates to the prototype.

E-Learning can use mashups to assimilate information from various services on the Internet and the mashups should be small, easily created interfaces, which are convenient to use and implement. Web services can be used to provide data to the mashups and mashups must be platform independent. (D. A. Baker & Rees, 2008)

Semantic Web

The Semantic Web is about how to implement reliable, large-scale interoperation of Web services to create a Web of machine-understandable and interoperable services that intelligent agents can discover, execute and compose automatically. Important issues related to the Semantic Web can be separated in four categories: Semantic Web languages, ontologies, semantic markup of Web pages and Semantic Web services. (Ghaleb et al., 2006)

Semantic web technologies are needed to represent information on the Semantic Web and make information syntactically and semantically interoperable across applications, specific languages (most of them are based on XML) need to be used. Resource Description Framework (RDF) is a framework to represent metadata, which is data about data. It comprises a triple of Object, Attribute and Value to describe any possible relationship between data. Resource Description Framework Schema (RDFS) defines the vocabulary of a RDF model and provides a mechanism to define domain-specific properties and classes of resources to which those properties can be applied. RDF Data Query Language (RDQL) is a query language for extracting information from RDF graphs. Ontology Inference Layer (OIL) is a higher-level ontology-representation language and is usually converted into an RDF/XML-like form and can be partially parsed by common RDF/XML parser.

Web Ontology Language (OWL) is used for representing ontologies and OWL elements are extending the set of RDF and RFDS elements. It is a set of XML elements and attributes, that are used to define terms and their relationships. (Ghaleb et al., 2006)

4.1.5 Web Architectures

The architecture of a Web environment for collaborative and cooperative learning must be provided with all the services necessary to establish and stimulate a virtual community. All participants share their specific knowledge and resources and each participant is acting as a provider and as a user of learning resources. The number of layers or tiers in a given architecture determines how the functionality of a system can be grouped. One major problem in the design of a client-server architecture is finding a solution that is compatible with the network security measures that may be in place, which may restricts the choice of network communication protocols. (Zheng-wang et al., 2008; Gehne et al., 2001)

Component-based architecture is a typical structure of a LMS. (Jabr & Al-Omari, 2010)

Service-based architectures take legacy application functionality and expose it to the Internet in a reliable, highly available, scalable, flexible, manageable and secure way. It's an easy and reliable Internet-based method to create and access learning. (Wikipedia, 2011)

Two-tier client-server architecture are used, when the user interface and course-delivery logic would be implemented on the client side and the database would be located on the server side. The client application does local processing, network processing and the connection to the database (Gehne et al., 2001). Oyelami (2008) developed an interactive language-learning system using a two-tier client-server architecture. At the client side, the language player interface and the authoring tool interface use the DBMS to access the course materials in the server via the HTTP protocol.

Three-tier architectures, as illustrated in figure 4.6, add a layer between the client and the database system. The user interface, the course-delivery logic and data access are separated and the client is only concerned with the user interface and connection to the server.

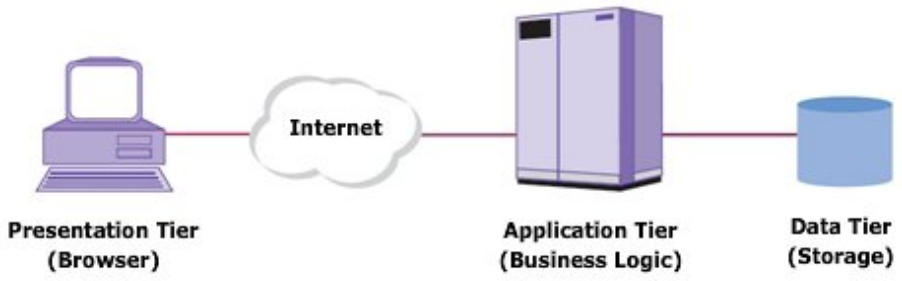


Figure 4.6: 3-tier architecture (Jabr & Al-Omari, 2010)

This client architecture provides increased security and flexible and significantly easier

maintenance. A web browser and Java applet provide the client software (Gehne et al., 2001). To provide an interoperable, pervasive and seamless learning architecture to connect, integrate and share learning resources (learning collaborators, learning contents, learning services) Jabr and Al-Omari (2010) provided a three-tier system architecture which consists of the following layers:

- Presentation Layer: The user interface is built to display data to the user or accept input from the user and contains text boxes, dropdown lists, gridviews etc.
- Business Logic Layer: This layer serves as an intermediary for data exchange between the presentation layer and the data access layer.
- Data Access Layer: The layer only interacts with the database and database queries or stored procedures will be used to access the data from the database or to perform any other operation.

Service-oriented Architecture is a distributed software architecture model which defines a set of principles and methodologies for designing and developing software. This type of architecture makes information technology more flexible and offers real platform independence and language independence. It make use of different function units of programs (services) and contract between services. The feature of SOA is service encapsulation, reuse of services and service integration. The structure of SOA includes three base elements: the service supplier, the service demander and the service registration, as illustrated in figure 4.7. (Honghui & Xiaojun, 2010)

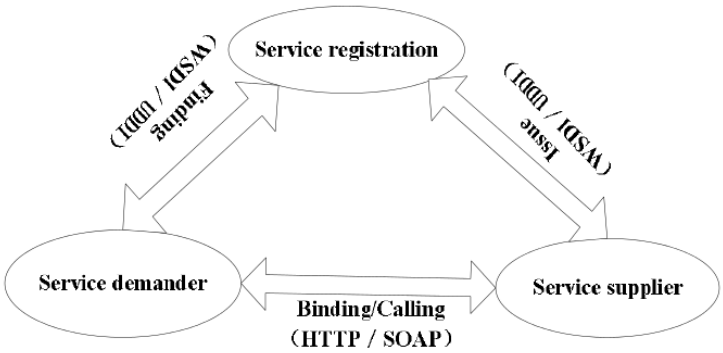


Figure 4.7: SOA architecture (Honghui & Xiaojun, 2010)

The service demander is the application program, software module or the service which needs another service. The service supplier is the entity which can be addressed through the network and the service registration supports the service finding. (Honghui & Xiaojun, 2010)

Web-oriented Architecture is a style of software architecture that extends SOA to web-based applications. Information is represented as resources and those resources are identified by URIs and manipulated via HTTP.

Web architectures are approaches to the design and planning of websites, which involves technical, aesthetic and functional criteria. Web applications are accessed over the Internet and use the Web browser as a client, so the Internet is used as a platform for interactive applications. (Ousterhoout, 2011; Wikipedia, 2011)

4.1.6 Web Applications

Web-based applications offer advantages like instant access, automatic upgrades and the opportunity to collaborate on a massive scale. Creating Web applications involves the integration of numerous technologies. Web services are a kind of web application which provides platform independent service component on the Internet. (Ousterhoout, 2011; Wikipedia, 2011)

There are many existing providers of Application Programming Interfaces (APIs) and frameworks for a common use in an E-Learning environment. To give some examples, the most famous providers are listed below.

Google[47] provides APIs to add and integrate services and functionalities allowing users to host applications on Goolge servers and Google is constantly adding new services. GMail is the Google-owned, web-based e-mail service and it is intuitive, efficient and useful. GMail has lots of space and offers free storage, offers mobile access, it has a search-oriented interface and a conversation view similar to an forum. GMail use the AJAX programming technique and runs on Google Servlet Engine and Google GFE/1.3 on Linux[48].Google Calendar offers users the possibility to order and manage appointments and meetings and multiple calendars can be made, but viewed in a combined mode. Guests can be invited or if they are Google Calendar users they can add the meeting directly and changed, deleted and accepted invitations can go to e-mail or Short Message Service (SMS). Google Calendar supports a notification by popup, e-mail or SMS.Google Docs is a free online productivity suite and includes documents, spreadsheets and presentations, which are competition for Microsoft Word, Excel and PowerPoint applications. Those types can be imported by Google Docs users and will be converted to the appropriate Google Docs format. Google Sites - former Page Creator - is a free and easy way to create and share rich web pages. Templates for e.g. clubs, wikis, company intranet, classrooms, project work sites and family websites are provided. iGoogle offers a personalised Google page, which provides instant access to multiple services like search the web, reading news, watching videos, maps, listen radio, chat with friends and much more on the own start page. It's a free service and includes theme changes and drag & drop gadgets. Gadgets are mini-applications built using HTML, with JavaScript, Flash or Silverlight for dynamic behaviours and tons of gadgets are available for free and any developer can access and develop own gadgets. (Google, 2011a)

Orkut by Google is a social networking website and is designed to help users to meet new friends and maintain existing relationships. Google Apps bundles a number of features

[47] `http://www.google.com/`
[48] `www.linux.com/`

and is available for individuals, for businesses and for education, illustrated in figure 4.8. Google Apps is a useful combination of web-based programs and file storage that run in a web browser. Users can simply log in to the service to access files and it not requires to buy or to install any software. Google Apps include communication tools (Gmail, Google Talk, Google Calendar), productivity tools (Google Docs), a customisable start page (iGoogle) and Google Sites for developing web pages. (Google, 2011a)

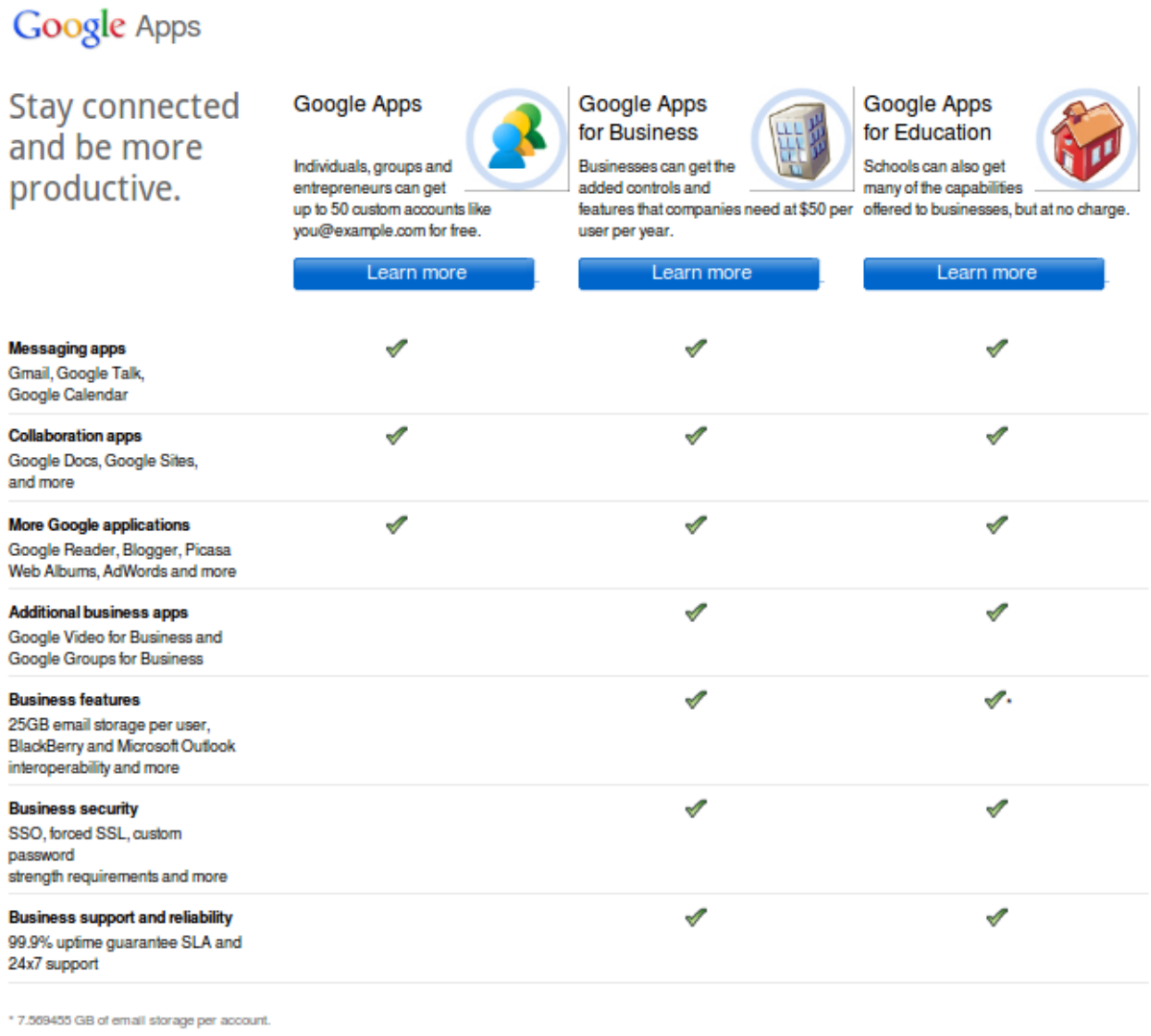


Figure 4.8: The three levels of Google Apps (A. Google, 2011)

Windows Live[49] is a collection of free personal services and the Windows Live SDK allows developers to build applications and mashups using Windows Live services. Live Spaces is Microsoft's free social networking platform where users receive a number of tools for them to use in their space including web logs, photo albums, E-mail uploads, music favourites and lists, contact cards, gleaming and permissions. (Live, 2011)

[49] `http://explore.live.com/`

Yahoo[50] provides access to the Yahoo-Portal via a framework for developers, but a separate host needs to be found to run the services created. The most prominent offerings from Yahoo are the Pipes and Widgets services. The Yahoo User Interface (YUI)[51] comprises a collection of development resources in JavaScript and CSS for creating rich web applications and is linked into Yahoo services (Yahoo home page, mail, Flickr etc.). YUI is an open source solution based on the BSD license[52] and can be used by developers as a base or supplement for a website. The resources are cross-platform and cross-browser because YUI uses AJAX and Dyncmic HTML (DHTML) for scripting and it extends the feeling and flow of the desktop to web applications (Yahoo, 2011). Pipes[53] are mashups, which allow users to aggregate data from various sources and provide all of the data through a single interface/point. Yahoos pipes can be accessed by widgets. (Yahoo, 2011)

OpenSocial[54] defines a set of programming interfaces for developing social applications that are interoperable within the context of different social network sites such as Facebook and MySpace. Using the OpenSocial standard, social networks can enable third-party to access their social graph and this opens many opportunities and social networks like Facebook and MySpace are using the OpenSocial standard to provide users with social applications. OpenSocial applications are based on the Gadget architecture, as depicted in figure 4.9, which has been expanded by interfaces that enable access to the social data found in the context of any given container.

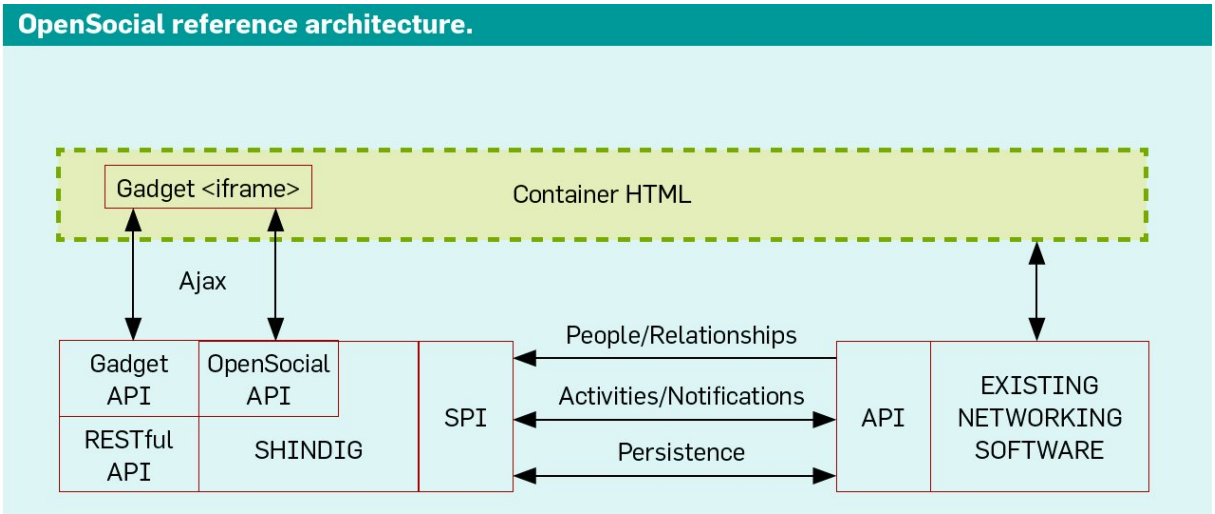


Figure 4.9: OpenSocial reference architecture (Häsel, 2011)

Gadgets are XML documents containing HTML and JavaScript along with metadata, and prevalent principles like AJAX and Representational State Transfer (REST) and the XML specification of a gadget is rendered by the container and integrated into its own web site. The communication between gadget and the container operates via AJAX requests.

[50] www.yahoo.com/
[51] http://developer.yahoo.com/yui/
[52] www.opensource.org/licenses/bsd-license.php
[53] http://pipes.yahoo.com/
[54] http://www.opensocial.org/

Containers support different views where gadgets may be rendered and a gadget can request through the API which views are supported by the container. Developers can use to call up HTML, JavaScript Object Notation (JSON), acXML and Atom data from remote servers and the gadget can also transfer data securely to a backend server, which whom social applications communicate to fulfill tasks such as making external content available or performing data management. The OpenSocial specification also includes a RESTful API that supports the formats AtomPub, XML and JSON. Containers must implement all of the OpenSocial JavaScript APIs methods and meet the Gatgets specification to be able to support the OpenSocial standard. Apache Shiding[55] is a reference implementation of the entire OpenSocial stack that operators of social network sites can refer back to. (Häsel, 2011)

The advent of OpenSocial increases a developer's scope and productivity considerably. Applications need only be developed once and can be implemented within the context of any given container that supports the standard. (Häsel, 2011)

WebTT[56] is a platform-independent Web-based interface and the main component is the diagnostic software The Turbo Tester (TT), which is being developed in Tallinn University of Technology[57]. The diagnostic software package, see figure 4.10, includes test generators, logic and fault simulators, a test optimizer, a module for hazard analysis, liner feedback shift register emulators for Built-In Self-Testing (BIST), design verification and design error diagnosis tools. WebTT has the same functionality as the standalone TT, an Internet connection and a common Web browser are enough for working with this system and the most important advantage of WebTT is the dramatic cost reduction in setting up the environment. In WebTT users using simple HTML web pages via HTTP Internet protocol and process their data and results even without installing this system on their local Personal Computer (PC). (Jutman et al., 2005)

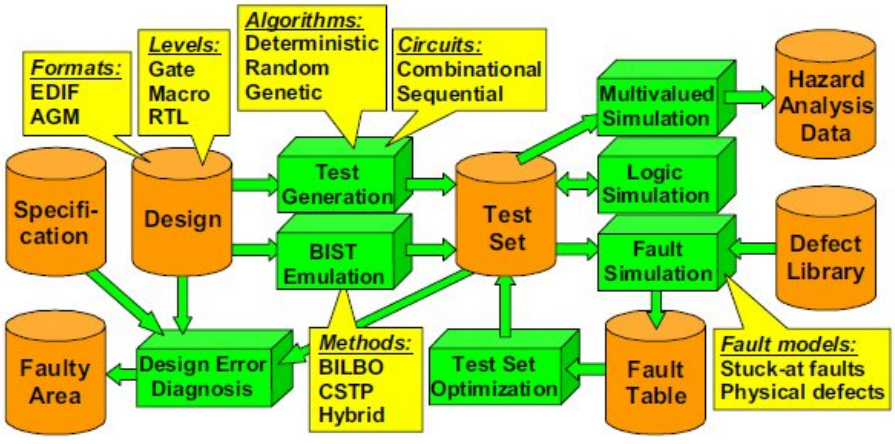


Figure 4.10: The Turbo Tester environment (Jutman et al., 2005)

The university can set up a server with a single hardware box and large numbers of

[55] http://shindig.apache.org/
[56] http://www.pld.ttu.ee/webtt/
[57] www.ttu.ee/en

students can simultaneously connect to the server, which requires Linux OS, Apache Tomcat servlet container and PostgreSQL[58] DBMS. TT performs all tasks on the remote server machine (Jutman et al., 2005)

Wix[59] is an online application which offers the possibility to create free, flexible flash websites without requiring knowledge of code. Wix provides a Drag & Drop editor which allows designers to create and customise professional-looking, Flash-based web sites easily. Wix is search engine friendly, because behind every Wix creation there is HTML code which can be crawled by a search engine. Search Engine Optimization (SEO) has always been a challenge for Flash-based web sites, but has been solved by Wix. (Wix, 2011)

4.2 E-Learning Approaches, Concepts and Frameworks

The purpose of this section is to present existing approaches and concepts regarding E-Learning discussed in the literature. To define needs for an E-Learning environment, also theoretical concepts need to be considered and possibly some approaches can be derived.

Knowledge must be context sensitive and learners must develop meta-skills, like the ability to analyse and critique information in order to judge the worthiness and value of information and the ability to synthesise information before learning itself begins. Constructivist instructional design principles involve providing a resource-rich learning environment, embedding learning in authentic problems, and emphasising continuous assessment during learning process. (Chen et al., 2009)

4.2.1 Conceptual E-Learning Environment

Chen et al. (2009, p. 3) presented a concept of an E-Learning environment for cross-cultural collaborative learning. The conceptual framework consist of four components, which are described in the following subsections.

Learning task

Learning tasks must provide opportunities for social networking, collaboration, share, and interaction during learning and reflection after learning to facilitate interactive and meaningful learning. Learning tasks define that learning activities hava a direct influence on group communication, collaboration and interaction. (Chen et al., 2009)

[58] http://www.postgresql.org/
[59] http://www.wix.com/

Networked community

Chen et al. (2009) stated, that networked communities or learning communities must be formed within an environment in which community members trust each other and feel comfortable in sharing knowledge, feelings, experiences, and values, to facilitate meaningful knowledge co-construction. A learning environment must provide a place for community members to get to communicate, socialise, share feeling and emotion and learn:

- Community association (organisation chart, member's role and responsibilities)
- Community member's profiles (profile of instructor/teacher, profiles of students)
- Community social place (community lounge)
- Community learning place (forum, library)
- Community help center (Q&A)

A resourceful and supportive learning environment has a significant impact on students' learning success. (Chen et al., 2009)

Resources

Resources and tools to facilitate comfortable communication and collaboration for working together as a community may assists students in acquiring knowledge. (Chen et al., 2009)

Tools for acquiring knowledge are *networking and community building tools* (NING, Windows Live Space), *communication and collaboration tools* for sharing of information and knowledge co-construction (Skype for communication; Google Docs for collaborative production; Blog, Wiki, RSS and Delicious for information sharing), *learning tools* (web search engines and browsers, Google maps, Google reader), *productivity tools* for building resources and assisting in accomplishing learning tasks and achieving learning goals (MS office apps, Audacity for pod cast media production) and *language tools* (online dictionary, translator, thesaurus). (Chen et al., 2009)

Materials to assist students are course or unit contents, general utilities (library, YouTube), job aids, manuals, handouts, best examples (sample work) and resources within a cross-cultural context. (Chen et al., 2009)

Support

Supports in technological, learning and social perspective, are required for E-Learning to be effective. (Chen et al., 2009)

Technological support is necessary for E-Learning. Inadequate technological skill combined with technical difficulties can result in frustration, confusion, and disorganisation for the learner and it may interrupt also the communication and interaction process. It

is necessary to provide an easily accessed, user-friendly technical support system to efficiently develop students' competence and comfort with technology is essential. The system should be designed to facilitate the completion of learning tasks. (Chen et al., 2009)

Chen et al. (2009) mentioned strategies for the design of technology support:

- Identify technology tools which are critical to the completion of the learning task.
- Provide easily-accessed, user-friendly, and focused technology resources such as job aid (step-by-step, to-the-point, action-based instruction for each required technology tool), FAQ, help-desk contact information, and technical support page in the course website.
- Create a community technical assistance center for community members to ask, give, and receive help when encountering a technology difficulty.
- Survey students' technological knowledge and skill background.
- Provide efficient technical training during course orientation.

Learning support provides structures during the learning process can help task engagement and goal achievement and must be designed based on the nature of the learning task. The design decision about the timing, level, form, and amount of learning support should be directed by the learning task and goal. (Chen et al., 2009)

Following strategies were stated by Chen et al. (2009) for achieving meaningful and efficient learning:

- Provide a virtual tour of the course environment, which serves as a cognitive map to familiarise the students with the learning environment.
- Increase the level, frequency, and amount of scaffolding (learning support structures) in instructional materials and procedures to assist in learning engagement and task completion - creating rich, easily accessed resources such as course calendar, best examples, FAQ, Internet resources, online library, and online experts.

Social support assist in meeting psycho-emotional needs of the learners and a social support system must be deliberately designed so that it yields effective learning through harmonious collaboration and interaction. (Chen et al., 2009)

Chen et al. (2009) presented strategies for supporting collaboration and interaction among community members:

- Forming heterogeneous groups (gender, geographic location) to help develop multiple perspectives.
- Fostering trust and comfort working in the community - introduce to the students the value of collaboration during the orientation.
- Offering emotional support - make the social forum available throughout the course for continuous social dialogue.

- Ensuring accountability - develop a set of grading criteria articulating the performance expectation to guide and ensure students' participation and contribution during group process.
- Enhancing effective peer review - use Blog for review interactions such as feedback, discussion and rating.
- Promotion dynamic interaction - student-content, student-student, and student-instructor (teacher) interactions

4.2.2 Web-based E-Learning Approach

Ray (2010) presents approaches and concepts in account of establishment of Web based E-Learning, as visualised in figure 4.11. Concepts like Web based course management systems (WBCMS) and Knowledge Management in Web based Learning Environment (KMWBLE) which can serve as motivational, instructional, modelling, feedback and assessment tools. Shareable Content Object Reference Model (SCORM)[60] is a collection of standards that enable interoperability, accessibility and re-usability of distributed Web based learning systems and is adopted by a lot of industrial and educational organisations as a set of standards to specify course structure and content delivery process.

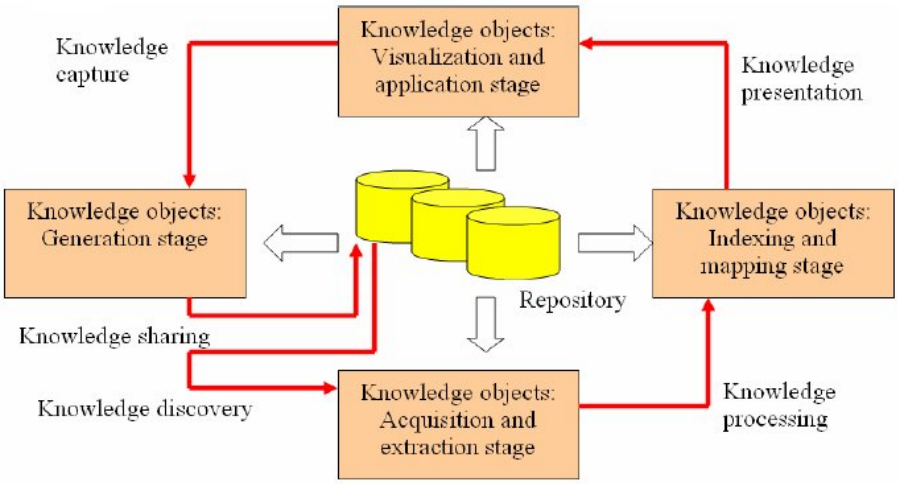


Figure 4.11: A top-level management model of knowledge objects in Web based learning (Ray, 2010)

Web-based Distance Distributed or online Learning (WD^2L) is a popular application for educational use which provides learners and educators with a wider range of new and interesting learning experiences and teaching environments. According to Ray (2010) it provides the following listed features of WD^2L:

- Interactive: interaction with students, instructor and Web resources via various communication channels and also an interactive feedback on students' performance is

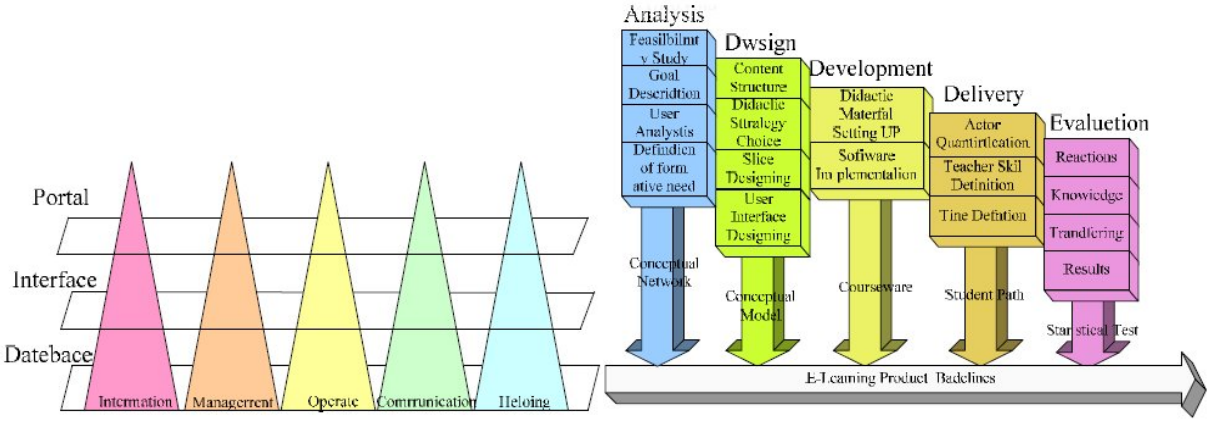
[60] http://scorm.com/

provided (discussion board, practice sessions, quiz).

- Multimedia: students' various learning styles using a variety of multimedia is supported (concept map, text to speech, advanced organisers).
- Distributed: downloading and printing the materials from the WD^{2}L environment and any other Web sources is provided (GPS resources, GPS glossary).
- Collaborative Learning: a medium of collaboration, conversation, discussion, exchange and communication of ideas is possible (discussion board by group).

4.2.3 Web-based E-Learning Environment

Zheng-wang et al. (2008) presented an architecture where it is necessary to take the categories of services typically available in a framework of web co-operation into consideration. Those services can be classified into information, management, delivery, communication and assistance services. The information services provide support for orientation within the E-Learning system. The management system collects and processes the data concerning the course organisation and tracing (e.g. user profile definition, access statistics, monitoring statistics). The delivery services allow correct and exhaustive fruition on part of didactic content users (e.g. evaluation tests, online didactic material). The communication services are tools for communication and the exchange of information for the collaborative and cooperative formative process (e.g. e-mail, messaging, chat). Finally helping services provide support for surfing within the course and the environments in which it's possible to ask for explanation and find answers for open questions (e.g. FAQ, assisted surfing). Figure 4.12 gives an overview about the Web-based E-Learning Environment.



(a) Information system **(b)** E-Learning life-cycle

Figure 4.12: Implementation of a specific information system for a Web-based E-learning Environment (Zheng-wang et al., 2008)

An important reference point in building an information system for E-Learning is the life-cycle of a E-Learning system product. Within the life-cycle the data are strictly prearranged and attention is focused on knowledge acquisition process and on dynamics

occurring between the learner and the learning content. It gives reference data about products, learning paths and interaction typologies among the actors of the learning process. (Zheng-wang et al., 2008)

4.2.4 E-Learning Management System using SOA

SOA defines how to integrate widely disparate applications for a world that is web-based and uses multiple implementation platforms. Jabr and Al-Omari (2010) presented an E-LMS with Web services oriented framework. The system is an open-source application with client-scripting facility, it supports cross browser and it is fully integrated with different databases (e.g. MS SQL Server, MS Access, Oracle and acLDAP). The key values provided by the architecture are interoperability, durability, compatibility, manageability, dynamic re-usability and accessibility. The proposed system is an advanced, 3-tier, database-driven architecture using Microsoft ASP.NET 3.5[61] with VB.NET[62], which is fully object-oriented implemented on the Microsoft.NET framework. Most of the transactions with the database are developed using client-scripting in order to enhance the performance of the system, which is divided into three phases: layout, database and web services.

- Layout phase: HTML, JavaScript, Adobe Photoshop CS[63], AJAX custom controls, for the login process where the JavaScript can communicate directly with the server using JavaScript XMLHttpRequest object, and CSS were used in web design.
- Database phase: This phase is connected with all other modules and Microsoft SQL Server 2008 is used as web storage.
- Web service phase: web services are used as references in most database actions (e.g. data manipulation through web services). Web services are web methods of functions that perform specific actions and they allow the system greater flexibility over the Internet by allowing it to work with other systems through the Internet. XML is used to transmit the data to and from different sources and web services can be considered as connectivity tools.

A three-tier architecture, illustrated in figure 4.13, was used and the system supports the facility of SCORM compliant. Instructor can develop learning objects using authoring tools and publish the output as SCORM files and those files can be deployed into the learning system as an IMS content package[64]. (Jabr & Al-Omari, 2010)

The application User Interface (UI) layer represents the presentation layer for the clients, which is a presentation tier in the 3-tier architecture. The UI has to be built to display data to the user or accept input from the user. The application UI can be the client program, which discovers and invokes the business processes or services from the service

[61] http://www.asp.net/
[62] http://vb.net/
[63] http://www.adobe.com/products/photoshop/
[64] www.imsglobal.org/content/packaging/

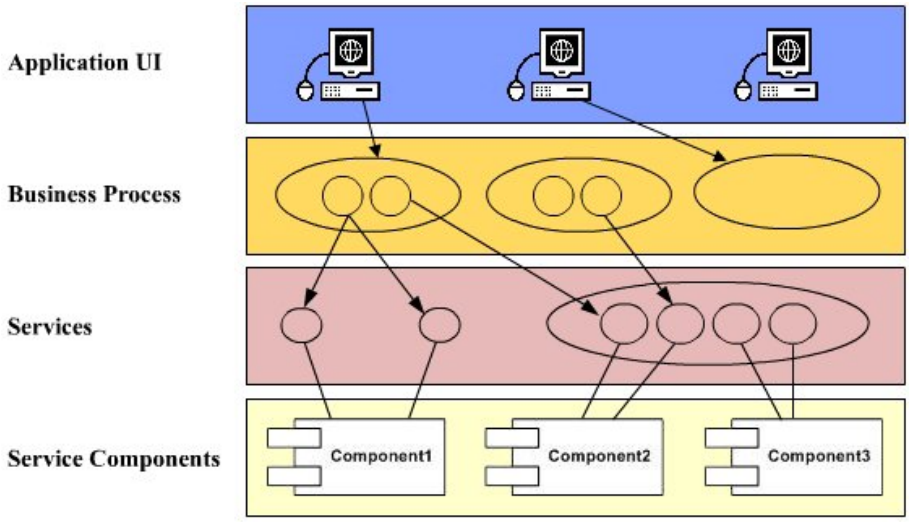


Figure 4.13: SOA Layers (Jabr & Al-Omari, 2010)

registry. The services, which are published to the service registry can be discovered and invoked through the Web Service Definition Language (WSDL) interface. The service registry is the dynamic component library that contains all services in the system. (Jabr & Al-Omari, 2010)

4.2.5 E-Learning-Systems in Use

There are many E-Learning platforms and environments available. To mention a few, the most well known are stated below.

Blackboard is the learning management system of e.g. the Curtin University and it is used University-wide. The system allows staff to post teaching content and materials, deliver quizzes and hold online discussions. It combines the essential tools of electronic communication, content presentation and class management in a single web environment. (Curtin, 2011)

WILE is a feature-rich LMS that uses combinations of available free or low-cost services and is available anywhere there is an Internet connection through a standard web browser, as illustrated in figure 4.14. WILE uses the concepts of Web 2.0 and transfers them to an LMS model, without making the environment more difficult to use. WILE is a mashup of technologies which links together in a useful manner and it supports assignment listing and submission, discussion forums, a grade-book and more. WILE considered an option that combined all of the learning content and associated windows encapsulated into one browser window and keeps the user in one environment, from the reading of assignment tasks to completing and submitting them. (D. A. Baker & Rees, 2008)

Google was adopted at the main WILE platform because most of the WILE features are covered by services from Google. The .ws extension from WILE was purchased from a third party provider and then configured in the Google Apps Dashboard. WILE is a mash-

Figure 4.14: WILE Web Desktop Environment (D. A. Baker & Rees, 2008)

up of some Google applications, Engrade[65], ClassMarker[66], and ProProfs Quiz School[67] to create a complete web-based environment and all required LMS service are encapsulated into a single 'web desktop' using Ext JS v2.0[68]. WILE is modular and components can be implemented on a class by class basis and most new services can be easily integrated. It encapsulates the services into one streamlined interface and differentiates itself from other LMS packages by requiring minimal development, extending web-based services already available and not requiring special plug-ins or specific browsers. WILE focuses on including reusable content and additional features can be easily added afterwards. (D. A. Baker & Rees, 2008)

Moodle[69] is a free, open-source PHP web application, which provides open-source community-based tools for learning. Moodle is available under the GNU Public License and suggests the use of Debian GNU Linux with a MySQL database, to keep the costs low. Moodle is very feature rich, but a support team needs to set up and maintain the operating system and the LMS installation. (Moodle, 2011)

[65] www.engrade.com/
[66] www.classmarker.com/
[67] www.proprofs.com/quiz-school/
[68] http://www.sencha.com/products/js/
[69] http://moodle.org/

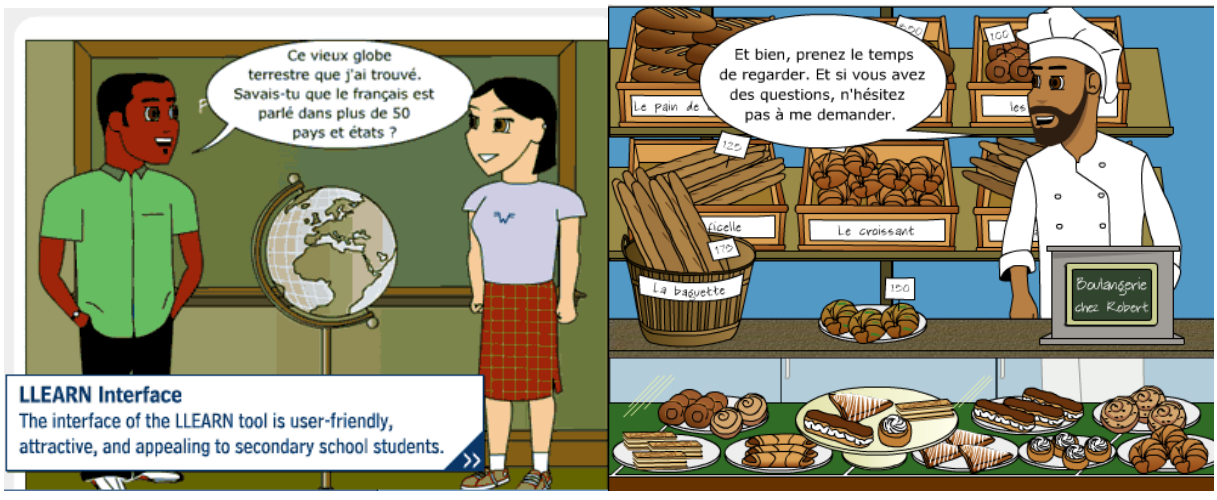
Sakai Project[70] is a community of educators collaborating to create open software that advances teaching, learning and research. Sakai is open source, needs to be installed locally and a support team is needed for the initial set-up and the hardware maintenance. (Sakai, 2011)

4.3 E-Learning Environments for Language Learning

The Web is full of E-Learning environments with a large scale of variance. The area of E-Learning environments specifically for language learning is not overcrowded, but there are already many showcase examples which offers willing learners to improve their English for free. Some selected language learning environments are listed in the following subsections.

4.3.1 LLEARN

Language Learning Environment and Resource Network (LLEARN) is a French language program which is designed for teachers and learners and incorporates text, audio and authentic French. Teachers can use LLEARN to develop and deliver high quality rich media content to their students. It can be used as a complementary resource to traditional classroom instruction or as a self-contained distance education course, as shown in figure 4.15. (LLEARN, 2012)



(a) LLEARN interface **(b)** LLEARN dynamic activities

Figure 4.15: LLEARN, French language program

[70] http://sakaiproject.org/

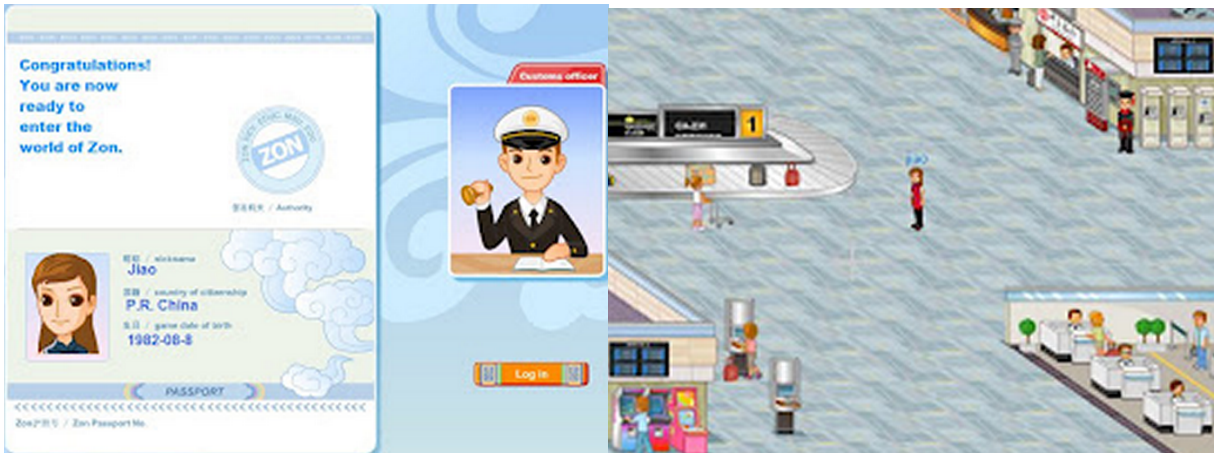
Findings

LLEARN is an user-friendly tool and offers communication tools, dynamic activities, games, vocabulary trainer and various learning content to the user.

But there is one big disadvantage, it is not free. Students have to pay Canadian Dollar (CAD) 19,50 and teachers CAD 40 for a one year license. (LLEARN, 2012)

4.3.2 Zon

Zon is a multiplayer online learning environment for teaching Chinese. It provides real-time, on-demand connection to interactive learning activities and cultural information. Within this virtual environment, learners can connect, practice Chinese and learn about the culture. Tutor sessions and live classes are held and it is possible to have one on one practices with other learners. This allows users to learn with various elements of the environment and also from other users within the environment. Zon is designed to provide social and environmental scaffolds to support the learning of users or so-called players. (Zon, 2012)



(a) Zon start **(b)** Zon virtual world

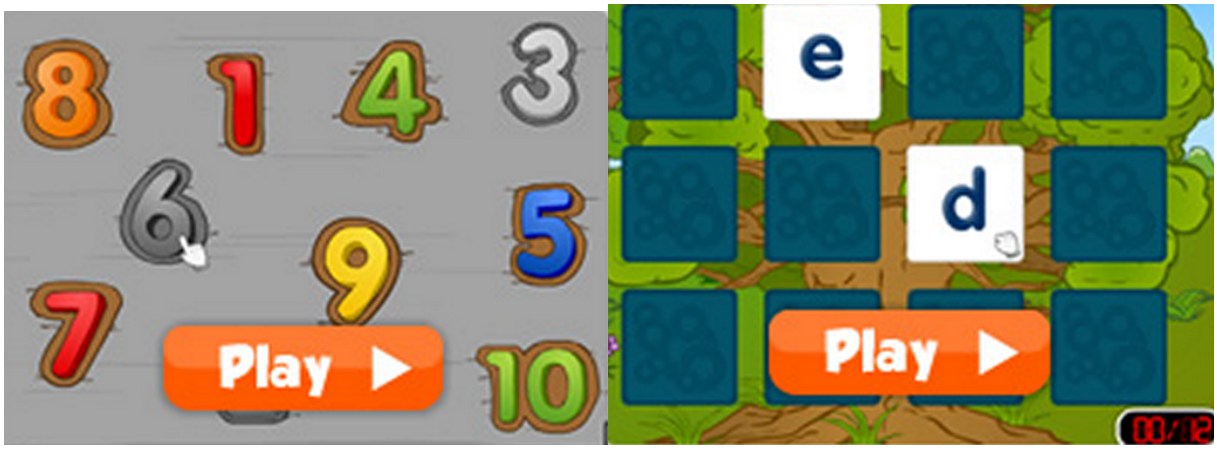
Figure 4.16: Zon, learn Chinese by playing (Zon, 2012)

Findings

Zon is more a video game, as shown in figure 4.16, that is primarily designed for education and it is built on some language learning theories, like on the premise that learning is interactive. It is possible to interact with other players or learners, non-player characters and responsive game agents. Zon is a free and funny role play game, which supports language learning as well.

4.3.3 Pumkin

Pumkin is an online English learning environment for children. It supports listening and speaking, reading through phonics and practising writing and typing is supported as well. Pumkin focus on five key areas: vocabulary, sentence and grammar, dialogues, phonics and reading and typing and writing. One hundred lessons and over seven hundred learning activities are available and the environment offers a daily report for parents, to see the progress of the children learning education. Further it provides community and fun features, where five virtual worlds are available to explore. In figure 4.17 two selected language games are presented. (Pumkin, 2012)



(a) Pumpkin, learn numbers

(b) Pumpik, learn and practice typing

Figure 4.17: Pumkin English lessons for Children (Pumkin, 2012)

Findings

The graphic of Pumkin is very nice and suitable for children. Especially the basis on learning by playing makes it very interesting for early child learning.

It offers some free English learning lessons, but to get all available lessons and activities, a user needs to pay around USD 30 per year. (Pumkin, 2012)

4.3.4 busuu.com

busuu.com is a language learning community which offers to learn languages online with interactive language courses and lessons. Further it offers the possibility to connect and talk to the community and to practice the language skills. busuu.com is available for 12 languages, among others it is possible to learn English, German, French, Italian, Russian and some more. (busuu.com, 2012)

As presented in figure 4.18, busuu.com offers more than just to learn a language online. Every member of the busuu-community can publish, which languages he is able to speak and which languages he is already learning or willing to learn.

Figure 4.18: Busuu.com - language learning community (busuu.com, 2012)

Findings

A busuu-user can connect to other users within the community, join learning or specific info groups with discussion boards or do some writing exercises which will be corrected by the community or designated friends within the community. Further it is possible to practice vocabulary or do other language learning exercises. The most impressive and important tool within the busuu-learning community is 'busuu-talk'. With busuu-talk, users have the possibility to talk to other users, language learners and native speakers in

the language to be learnt. This makes busuu.com very special, as it not just provides a lot of language learning actions, it supports the essential part of language learning: speaking.

Busuu.com is free, but offers the possibility to purchase a Premium account, where access to additional functions such as grammar units, pdfs and podcasts is offered. (busuu.com, 2012)

4.3.5 italki

italki is an online language learning environment which helps language learners to meet online and to do free language exchanges. On the one hand it is a social networks, where users can become friends, have a chat and may follow each other, like the principles of Twitter. On the other hand it is a marketplace, where students can connect to language teachers for paid online lessons. It further offers many free language learning features, like questions and answers, group discussions and multimedia materials for self-study. The principle of italki is pretty easy. It is possible to learn or improve the designated language by self-study and it offers private online learning lessons with language teachers which need to be paid by the learner. Therefore it is first necessary to buy italki credits (ITC) with credit card, PayPal, InstandBanking or similar paying options. After that the user owns the uploaded amount of ITC, where 10 ITC are equal to USD 1. On the marketplace, all language teacher are listed with the language they are speaking and which they are teaching. Further the hourly rate is presented, many of language teachers offer special prices for trials. The possibility to rate the language teachers, as imaged in figure 4.19, is one of the most important aspects of italki. (italki.com, 2012)

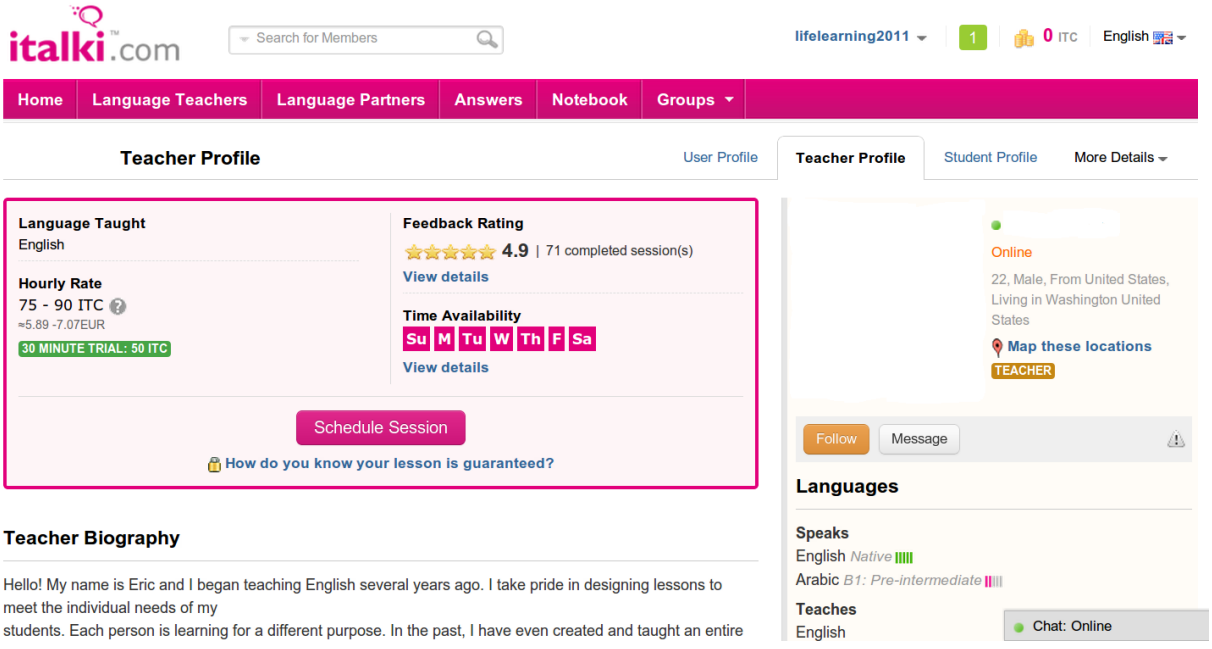


Figure 4.19: italki.com - Language teacher profile (italki.com, 2012)

Previous users, who have taken a learning hour, can rate the language teacher and the quality of the paid lessons. So every language learner can see, how many lesson a teacher has completed and what the average rate of the lessons is. (italki.com, 2012)

Further italki provides so-called language partners, similar to busuu.com, where users can become friends or just follow the certain partners and their posts. A messaging mechanism is offered to exchange with others language learners for free. (italki.com, 2012)

Findings

italki is a well constructed learning environment for language learning. Even when lessons with language teachers need to be paid, it is a quite good solution to practice and improve the personal language skills. The rating mechanism to assess the quality of the language teachers is a very good idea as well. The provided social network and place to exchange with each other keeps the user motivated and attracts' the users attention constantly.

4.3.6 UniLang

UniLang is a language community which offers many language resources for a wide variety of languages. Language courses, grammar references, as shown in figure 4.20, pronunciation guides, phrasebooks, games and exercises are provided. Even as a not registered user, various language learning possibilities are offered to learn and practice English, Russian, Arabic, German, French and some languages more. The learning resources are categorised in courses, videos, audios and podcasts, grammar, dictionary, pronunciation and script, vocabulary, phrasebooks, stories, games and exercises. Further UniLang supports forums for general topics, a general language forum and language-specific forums. A free voice chat, to connect and talk to other learners is offered as well, but installing further software is necessary for that. Finally an almost all-encompassing wiki is available for any kind of question or as an information database. (UniLang, 2012)

Figure 4.20: UniLang Language Community - grammar references (UniLang, 2012)

Findings

For creating an account, a valid e-mail address, a name, password, country, gender and a birthday need to be provided by the account creator. Then a link for account activation is sent to the e-mail address. This link needs to be followed and then the account is ready for use. Every user has his own profile, where he can add changes or set the languages he speaks and wants to learn. Further every user has his own blog where he can talk about whatever he wants. UniLang provides a lot of functionalities as well and is free to use.

4.3.7 English, baby!

English, baby!, or Ebaby, offers English chat rooms and forums, it consists of a customisable vocabulary trainer, English quizzes and downloadable English mp3 audio files. Further it supports the social aspects as well and offers every user an own profile to find international friends. (Ebaby, 2012)

Findings

After successful registration, an user can use some provided material within the learning environment, like a chat, blogs, listening or vocabulary quizzes and read and try grammar exercises. There are a lot of advertisings on the Web page, which makes it sometimes difficult to orientate. Immediately after registration a so-called "Super membership" is offered which has a 7-days free trial. After declining this offer, a normal use of the provided tools is possible, but there are always more or less hidden invitations to upgrade. E.g. Ebaby offers a lesson of the day to its users. But for the majority of the content, even for the large advertised mp3 audio files, within the Ebaby-Web page it is necessary to be a Super member, so it can be stated that Ebaby is not a free service.

4.4 Conclusion

After the excursion through the literature and current standards regarding E-Learning technologies, needs and necessities for an E-Learning environment and the users had to be derived. As the Internet supports open learning with its device, platform, time and place independence it can be seen as the basis of any E-Learning environment. An E-Learning platform needs to be affordable, efficient, easily accessible, open, flexible and learner-centered. It needs to be compliant with latest web application standards and must have a pleasant, practical design. Synchronous and asynchronous communication methods are obligatory for interactivity within an E-Learning environment. The opportunity for personalisation, collaboration and source sharing are key characteristics of an meaningful E-Learning system which ongoing can attract the users' attention. In a addition to a source of information, the Web has become a platform for users to socialise and work with each other.

From the literature and conceptual frameworks it can be derived, that learning tasks within the environment must provide opportunities for social networking and interaction during learning and reflection after learning to facilitate meaningful learning. Further the learning communities must be formed within the learning environment so that community members trust each other and feel comfortable in sharing knowledge. Resources and tools to communicate and collaborate assist learners to acquire knowledge and therefore such tools are an essential part of every learning environment. Finally support in technological, learning and social perspective is indispensable for E-Learning to be effective.

While having a deeper look on related work in the online language learning area, some essential requirements could be derived for designing and creating a language learning environment. An E-Learning environment should be designed for learners and for teachers, to offer self-study and instructor-led learning. An E-Learning environment should be built on learning theories and learning should be held interactive. Offering communication tools, dynamic activities, vocabulary trainer, listening and speaking and various learning content and practical examples is important, to attract and to keep the users attention and motivation. Interactive language courses and lessons offer an effective way to learn a language within an online community and therefore real-time tools need to be provided by a certain tool. Discussion groups and blogs are important as well, because there an user gets the possibility to receive comments from a wide group of users. The social aspects need to be considered while designing an E-Learning environment as well. In the area of Facebook and MySpace, social networking is the magic ingredient for the success of an online environment, whether it is for language learning or some other purpose. Especially keeping in mind the local separation of E-Learning, the social interaction within the environment needs to be supported to minimise disadvantages of online learning, like the feeling of isolation.

The upcoming chapter describes the establishment of the requirements for the prototype, separated into functional and non-functional requirements. Further a small evaluation phase or so-called platform selection process was the basis to find an appropriate platform for implementing the E-Learning prototype.

Chapter 5

Requirements and Selection Process

This chapter describes, how the requirements for the prototype were established, then it outlines a conceptual architecture and finally it shows the selection process of an appropriate platform to use as a basis for the prototype implementation.

The definition of the requirements for the prototype was done in a three-steps procedure, as illustrated in figure 5.1.

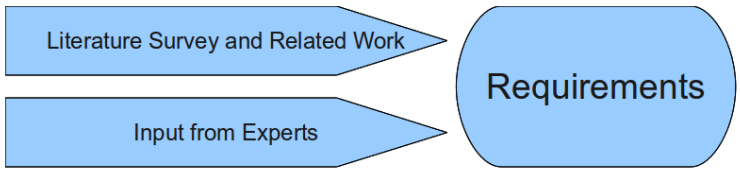


Figure 5.1: Defining requirements for the prototype

First requirements and specifications for the E-Learning prototype were derived from the literature and related work, which concludes existing E-Learning environments for the application domain language learning. After that, the domain experts Dr. Christian Gütl[1], Dr. Vanessa Chang[2] and Dr. Arthur Edwards[3] gave additional input regarding desired and appreciated functionality. Finally functional and non-functional requirements were specified from previous defined requirements from literature, related work and domain expert.

[1]Graz University of Technology
[2]Curtin University Perth
[3]Universidad de Colima

5.1 Requirements of the Language Learning Environment

Nowadays E-Learning is an affordable and efficient way to learn a language without any constraints in time and geographic location, because it is available when and where it is needed. But many matters need to be considered while designing and implementing an E-Learning system, especially for language learning because learning a language is a complex process anyway. When taking the spatial separation, the feeling of isolation and the personal responsibility due to no control into account, there are many essential components to a successful and useful E-Learning environment, which needs to be considered. Therefore literature and related work has been analysed to form the big picture, about what is needed to cover the most important parts of such an E-Learning system with the purpose to offer free, interactive learning, training and teaching opportunities. Finally the derived and defined requirements were completed by the input from domain experts.

5.1.1 Derived Requirements from the Literature and Related Work

The comprehensive literature survey, which was performed before the definition of the requirements, is the basis for some selected requirements of the E-Learning prototype.

Key Characteristics

English as a foreign language is the most widely used of all living languages. It is a challenge to learn and to teach English, so the quality of the input plays an important role across different perspectives to second language acquisition.

E-Learning needs to be open, flexible and distributed. As different types of learners are using E-Learning systems, it is necessary to provide the willing learners with individual learning support. Interaction is one of the key components, whether technology is involved or not and is therefore the essential ingredient of any learning environment.

From the pedagogical point of view, monitoring students and their progress in learning is important to intervene if necessary. Traditional learning is teacher-centered, the modern learning is student- or learner-centered and so it is important to improve the pedagogical factors under themes of personalised E-Learning. The learner-centered approach includes concepts of self-education and life-long education.

The personal, social and cultural background need to be considered as well during second language teaching. Assessment and feedback play an essential role within the learning process and therefore those aspects should not be underestimated. Feedback can enrich an online learning experience and if learners can evaluate provided learning material it improves the quality.

Further adult learning strategies differ from child learning, while adults must have a sense of purpose, children accept what they are learning when they are told to.

Language learning occurs through social interaction, so it is essential to provide an E-Learning environment with social networking options. Otherwise it won't be successful and learners would soon loose their motivation to learn and the progress would also be much slower.

E-Learning should be low-cost, the attention of the user needs to be attracted, social aspects need to be considered and interactivity is one of the main keys to a successful platform. Special needs in relation to cross-nations, cross-cultural and distance learning must not be forgotten. To keep all those aspects in mind while developing an E-Learning platform does not guarantee success, but is a major step in the right direction.

Related work in the online language learning area show, that all available environments offer communication tools, activities for language learning, games, various learning content, allow interaction with other users or learners, support learning groups for special interests and provide language specific exercises.

5.1.2 Domain Experts

Further to the requirements derived from the literature survey and related work, the domain experts stated some additional requirements as well. The E-Learning environment should be useful for just self-study language learners but also for classrooms, where a teacher has his classrooms within the learning environment and students work together within this classroom. As also handled in Boruta, Chang, Gütl, and Edwards (2011), further additional requirements are listed below:

- Synchronous and asynchronous communication with chat, e-mail and a mailing list.
- Synchronous and asynchronous collaboration with a collaborative writing area and a wiki.
- Coordination providing a calendar functional.
- Podcasting images, videos and documents.
- Tools for learning support with dictionary, spell checker and text-to-speech.
- Quality and feedback, where learners can evaluate learning material and teachers and learners as well can give feedback to published articles.
- Single-sign-on, all functionalities and tools of the E-Learning prototype should be available after signing in.

In the last step of the requirement engineering, the previous stated requirements were separated into functional and non-functional requirements.

5.1.3 Functional Requirements

The functional requirements define, which kind of functionality the prototype needs to provide, so they are part of the system design. Those requirements are separated into

overall functional requirements and application domain specific requirements.

Overall functional requirements:

- Enable synchronous collaboration and communication (share documents and images, real-time collaborative writing, chat).
- Enable asynchronous collaboration and communication (mail and mailing lists, forum, wiki, document and image repositories).
- Support user customization (personalize personal pages).
- Enable group coordination (group calendaring, poll).
- Support media types (documents, images, videos).

Domain specific functional requirements:

- Handle two different types of actors within the learning environment, the teacher with extended administrative rights and the learner or student.
- Enable auditing and monitoring (evaluation/rating mechanisms, feedback, monitor user activity).

5.1.4 Non-Functional Requirements

The non-functional requirements define, what kind of properties the prototype should have. They are part of the system architecture.

Non-functional requirements:

- A low-cost solution (combination of open-source and free technologies).
- Easy to set up and easy to use.
- Provide scale and reliability.
- Be adaptable to different learning methodologies (offer flexibility to certain users, single sign-on).

5.2 Conceptional Architecture

Demands of more social interaction, more flexibility and more functionality within one single environment could be identified while evaluating existing literature and related work in the online language learning world.

When summarising the previous stated key characteristics of an E-Learning environment and the defined requirements, the E-Learning tool should support language learning and training in general, the specific application domain is English learning and training

as second language. Language learning bases on teaching followed by learning by doing (training), discussion groups, demonstration, audio-visual, reading and listening. The tool should be a mashup of different services to create a Web-based environment that is easy to use and the learning environment is also complemented by teaching materials that are available on the Web. The learning environment should act as a virtual environment for self-study and offer teaching possibilities. The tool needs to be flexible, open-source, low-cost, functional, suitable for language learning and social networking supportive.

Therefore the E-Learning prototype needs to consist of an appropriate CMS where the user management with according single-sign-on mechanism and the service management is handled. Templates are used to automatically generate user pages for new users or classrooms. Social networking tools, communication and collaboration tools need to be provided.

As derived from Yuan (2010), figure 5.2 illustrates the conceptual architecture of the E-Learning prototype where all requirements are tried to taken into account.

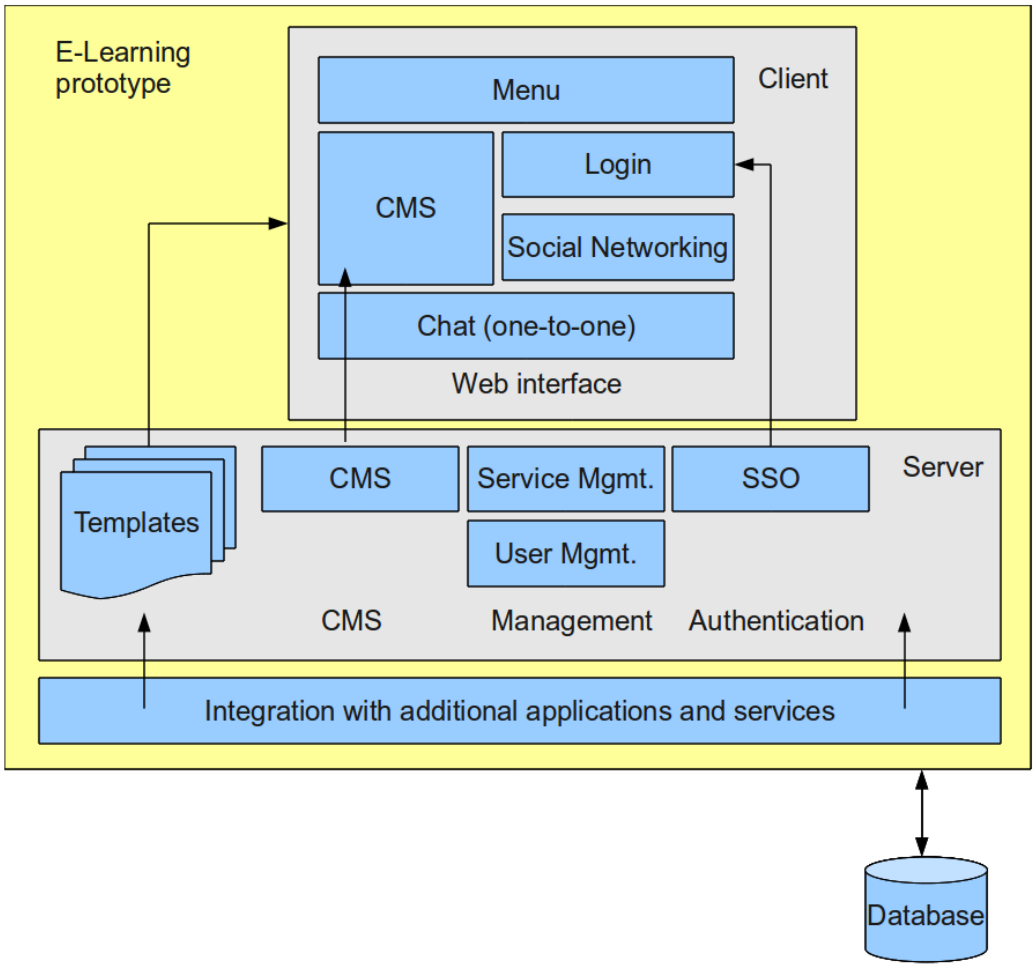


Figure 5.2: Conceptual architecture

This conceptual framework does not show the real architecture. The purpose if this figure was, to collect the requirements and according technologies into one picture. This makes it easier to understand, what is needed for designing and implementing the prototype.

From the server side the E-Learning environment needs to provide a CMS, needs to support certain management tasks and single sign-on. On the client side the E-Learning prototype needs to provide an easy-to-use web interface with login, CMS articles, social networking and chat support. Additionally it is necessary to realise integration with pre-existing Web 2.0 service and applications. The approach to combine an online language learning environment with a social network and support different learning methods, like self-study and instructor-led learning, represents the challenge of this work.

5.3 Evaluation Process of an Appropriate Platform

To present a flexible integration model and to make the E-Learning environment intelligent and adaptive to each individual learner or user, the tool is based on Web-based services and technologies. A comprehensive research on Web applications and frameworks has suggested some few possible methods for the implementation, which have been evaluated during an extensive testing phase:

- Google Sites using the Start Page template, which makes it possible to create an controlled and a customisable area.
- iGoogle with Google Apps as frame for gadgets, where teachers, group-coordinators, administrators or tutors can lock gadgets, specify default gadgets and add content.
- The ROLE project, which aims to develop a framework for truly learner-centered personal learning environments.
- Liferay open-source portal software, which provides a robust feature set, scalability, development tools and a flexible, scalable architecture. It brings a lot of out-of-the-box functionality with it and is widely used for building dynamic, social systems.

The above mentioned prototype candidates have been evaluated and used in small projects to find out which one is the best for the implementation of the prototype. The most important criteria for the selection of the method of solution have been: simplicity, wide variety in field of application and cost-effectiveness.

5.3.1 Google Sites and Google Apps

Google Apps for free[4] was used for the evaluation phase, which covers just basic functionality (Gmail, Google Sites, Google Calendar, Google Docs) and is maximised with 50 user accounts. (A. Google, 2011)

[4] `http://www.google.com/apps/intl/en/group/index.html`

In course of this testing phase, a webpage 'Gratin English' using Google Sites has been created. The creation of a web page is very easy using Google Sites. A site can be private or shared, in case a page is set to be shared, everybody is able to see the content of the page. When it is set to private, just users with permission are able to access those private sites. Every private site can be published as public or as shared ones. Google Apps offers many site-templates, which makes it very easy and quick to create new Web pages. Five choices are available for creating a new page: Web Page, Announcements, File Cabinet, List and Start Page.

The Start Page Template is a very powerful template, which makes it possible as a Google Apps administrator to create a Start Page for the users. This page is then the users' homepage, on which the users can access their Google services and other content on a, by the administrator, specified part of the page. So the administrator can add content, like images and gadgets in a locked area, which users can't modify. So when the administrator needs to modify parts of the locked area, all users' Start Pages will be updated automatically. As administrator it is also possible to specify a blacklist and a whitelist for available gadgets. The Google Apps prototype consists of shared and private pages, see figure. For every single page within the prototype, permissions can be set whether groups or single persons have access to the designated source.

Problems with Google Apps

The Start Page in Google Sites doesn't add a Start Page link at the top of users' Gmail or other Google service page (Google, 2011b). The main problem is, when a user is logged in to the Gratin-Prototype and per example navigates away from the learning site to his Gmail-Account, there is no possibility to navigate back to the prototype without using the back-button of the browser or entering the URL of the prototype into the browser again. So if an user doesn't know that, he'll get lost. If he navigates within his Google Account to Google Sites, he won't be able to access the prototype, because the user isn't the owner of the site and so gets only the possibility to create his own Google Site. This strange behaviour hasn't been solved until now and has been criticised by many Google Apps users.

5.3.2 iGoogle

iGoogle[5] is comparable to Google Apps, with the limitation that administrators can't prevent users from accessing inappropriate gadgets or themes, like per example adult-oriented gadgets. Organisations, schools and university sure do not want to use this as an option. (iGoogle, 2011)

It is possible to use iGoogle and gadgets over the Google Apps infrastructure as a framework using iGoogle with Google Apps for corporative Personal Learning Environments

[5] `http://www.google.com/ig`

(PLEs). Casquero, Portillo, Ovelar, Romo, and Benito (2008) presented a framework for the integration of institutional and external services.

Problems with iGoogle

Within iGoogle a certain user access prevention is not possible. In particular this means, that there is no functionality to prevent users from accessing inappropriate gadgets, no private gadgets for the domain are available and content areas can not be locked.

5.3.3 ROLE

The ROLE Project[6] aims to build a framework that allows a learner to construct and maintain an own Personal Learning Environment (PLE). ROLE offers adaptivity and personalisation in terms of content and navigation and the entire learning environment and its functionalities. The ROLE infrastructure will empower the learner for true lifelong learning across institutional boundaries. (ROLE, 2011)

ROLE's expected result: For the learner and teacher, the ROLE infrastructure enables for the first time a truly learner-centred PLE. The ROLE infrastructure will empower the user for true lifelong learning across institutional boundaries. The integration of learning with other parts of the learner's social life will be considerably facilitated, thus increasing motivation for and effectiveness of learning. The ROLE learning services and tools will create new opportunities for collaborative learning and learning communities as well for emerging markets. (ROLE, 2011)

Problems with ROLE

The ROLE project just started in 2009 and expires in 2013. As it is an ongoing collaborative project with many releases, an incomplete documentation and a small developer community are a big disadvantages when developing an E-Learning prototype. There weren't responses to questions regarding the source code and further information, which makes it pretty hard trying to use a unfamiliar framework. While trying to combine a ROLE-widget (dictionary) with Liferay, the widget wasn't loadable anymore without any explanation or apparent reason.

5.3.4 Liferay

Liferay portal[7] is an open source software platform for building websites and web applications and it uses the latest Java and Web 2.0 technologies (Sarang, 2009). It offers a robust feature set, scalability, development tools and a flexible, scalable architecture

[6] http://www.role-project.eu/
[7] http://www.liferay.com/

that is open source. It is compatible with the major databases, operating systems and app servers. Liferay comes with over 60 out-of-the-box portlets, which are pluggable user interface software components and are managed and displayed by the Liferay portal. All of the functionality provided by Liferay is encapsulated behind a layer of services that is accessed from the frontend layer (the portlets). (Liferay, 2011a)

The pre-existing funcionality offered by Liferay can be categorised in Content Management & Web Publishing (built-in CMS), Collaboration (Blog, Wiki, RSS) and Social Networking (Social APIs). Liferay supports OpenSocial[8] which enables a more general inclusion of widgets. One of the benefits of Liferays' architecture is that it is possible to change how a core portlet of Liferay behaves without changing the portlet itself, customizing the backend services that it uses. Further it was successfully combined with ROLE[9] and many companies, universities and other organisations are using Liferay for their web appearance.

Problems with Liferay

The documentation is good but not complete. Handling a framework that brings a lot of functionality with it is not always easy, because it is less flexible. So it's not easy to find a solution for every problem that comes up during the development. The support as well, when the community version of Liferay is used, is not very good.

5.4 Selection of the Appropriate Technology

Boruta et al. (2011) outlined, that all evaluated platforms have their advantages and disadvantages. According to that finding, seven key criteria where defined for the selection process: low-costs, quality of documentation and support, flexibility and customisation, support for social interaction, combination with existing tools and services, support for self-study and instructor-led learning methods and support of synchronous and asynchronous communication methods. '✓' means that the assessment of the specific criteria is good enough to consider the respective platform for the prototype implementation. A '-' means that the performance regarding the observed criteria is ok, but could be better and the 'X' means, that the criteria isn't fulfilled at all.

	Google Sites & Apps	**iGoogle & Apps**	**ROLE**	**Liferay**
Low-cost	✓	✓	✓	✓
Quality of documentation and support	✓	✓	X	✓
Flexibility and customisation	-	-	✓	✓

[8] http://www.opensocial.org/

[9] www.carstenullrich.net/pubs/Friedrich11Early.pdf

	Google Sites & Apps	**iGoogle & Apps**	**ROLE**	**Liferay**
Support for social interaction	✓	✓	✓	✓
Combination with pre-existing tools and services	✓	✓	✓	✓
Support for self-study and instructor-led learning methods	✓	✓	X	✓
Administrator can modify access preventions	✓	X	-	✓

Table 5.1: Platform Selection Process - defined criteria

Beneath stated key characteristics, which were derived from the literature and related work, the prototype need to offer a lot of functionalities. Therefore the selection of an appropriate platform is a very important step and can be relevant for success or failure.

5.5 Conclusion

The unexpected and uncommon behaviour according to the missing Start Page link was the main reason for the rejection of using Google Apps for implementing the prototype. The missing user access prevention disqualified iGoogle for the prototype implementation. The ROLE project just started in 2009 and expires in 2013. As it is an ongoing collaborative project with many releases, an incomplete documentation and a small developer community, the decision was made not to use the ROLE framework.

Liferay has some disadvantages, but it offers the most functionality and is open-source, which makes it easier to adapt and to configure to meet the needs of a language learning environment. As all criteria are fulfilled by Liferay, it was chosen as the basis for the E-Learning prototype.

From the development point of view, it is very comfortable that Liferay brings a lot functionality out-of-the-box, but working with powerful portal software can be complex. When using a portal software like Liferay, it is necessary to read yourself into the topic and to get along with the huge amount of code. Managing just a small part of the provided functionality is a challenge itself. As a developer it is necessary to be aware, although a lot of implementation work is already done due to the available out-of-the-box functionality, that a lot of time must be counted for reading forums and searching discussion groups for occurring errors which are not well documented.

Liferay provides many online resources and documentation, but as it is an open-source software, the quality of the available materials isn't as constant as it should be.

Chapter 6

Prototype

After the extensive literature survey regarding E-Learning, according technologies and the application domain language learning, the requirements of the prototype were pointed out in chapter 4. The previous chapter described the platform selection process, where finally the Liferay portal platform software has been chosen for the prototype implementation. This is due to that Liferay is seen at the most appropriate platform for the implementation of the prototype. This chapter deals with Liferay portal software, the prototype architecture and the according implementation details. It shows how the portal is configurable and adaptable for special needs of several users.

The results of the evaluation phase pointed out, that with using Liferay portal software as the basis for the prototype, almost all requirements are possible to implement.

6.1 The Big Picture

The set target of this work was to identify suitable Web 2.0 technologies and tools and combine them within an E-Learning environment for the application domain English. Therefore requirements for the language learning prototype were derived from the literature and related work. Those derived requirements or key characteristics were completed with further input from domain experts within the online learning area. Beneath stated key characteristics, like the environment should be low-cost, attract the users' attention and flexible enough to meet specific users needs, the prototype offers various functionalities. The prototype supports self-paced and instructor-led learning and offers space to learn, to train and to teach English. Further synchronous and asynchronous communication and collaboration functions are provided and publishing functions, for uploading documents and images, are implemented. The evaluation of provided learning material is realised and the quality of published forum entries can be rated. Additionally the language learning prototype is provided with teaching and training material available on the Web and acts therefore as an information repository for English language learning. One big problem of E-Learning is the isolation factor and the high level of self-reliance. Therefore

social networking is the magic ingredient to keep users motivated and to establish some kind of connection to the environment, or better to say establish connections to other users within the environment.

6.2 Liferay Portal Software

Liferay is an open source portal and collaboration software written in Java and distributed under the GNU Lesser General Public License[1]. Liferay is a portal server, which means that it is designed to be a single environment where all of the applications a user needs can run. The applications are integrated together in a consistent and systematic way. Liferay uses standard Java and JavaScript, along with built-in SOAP and JSON support for web services. (Liferay, 2011a)

6.2.1 Liferay Architecture and Technologies

Figure 6.1 gives a compact overview about the architecture of Liferay. Liferay supports Windows, Mac and Linux and Java Runtime Environment (JRE) is installed on the supported Operating System (OS) to host the Java Virtual Machine (JVM).

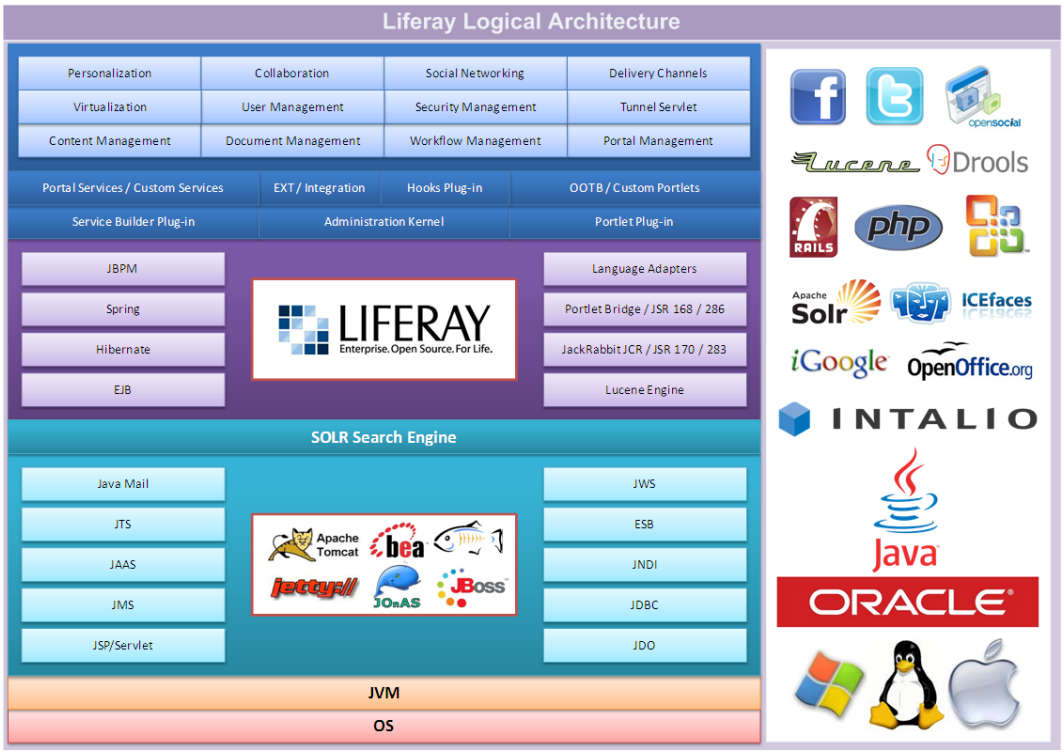


Figure 6.1: Liferay Logical Architecture (Liferay, 2011a)

[1] www.gnu.org/licenses/lgpl.html

An application server is required which contains the Liferay instance. The supported servers include Apache Tomcat, Glassfish, Geronimo, Jetty, JOnAS, JBoss, and Resin. Most of these servers are available as bundled versions for download and are deployed in the JVM container. The server provides connectivity and interoperability using an Enterprise Service Bus (ESB), and there are multiple services offered by the servers which are leveraged by Liferay. To give a few examples: Java Database Connectivity (JDBC), Java Message Service (JMS), Java Authentication and Authorization Service (JAAS), JDO, JWS, JSP/Servlets, JavaMail. Liferay uses a number of technologies like Enterprise JavaBeans (EJB), Hibernate and Spring. Further Liferay implements Lucene Search Engine by default and Liferay provides a portlet bridge to deploy JSR 168/286 portlets. Liferay contains language adaptors such as for Python, Ruby and PHP which allows easy integration. (Liferay, 2011a)

Portlets

Portlets are web applications that run in a portion of a web page and a portlet project consists of three component at a minimum: Java source, configuration files and client-side files (*.jsp, *.css, *. js, graphics, etc.). New portlets are written in Java and get added to a Tomcat server, the project must contain the Dynamic Web Module 2.4.. The core of Liferay is a portlet container, and it aggregates the set of portlets that are to appear on any particular page and display them properly to the user. (Liferay, 2011a)

Hooks

Changes of the core can be reached with a hook. Hooks are used to customize the portal without touching the code part of the portal, which is done by overwriting existing .js and .jsp-files of the Liferay source code. It is also possible, to change the core direct in the portal, but via a hook makes it much more valuable for the future. E.g. if there is a good reason to upgrade or downgrade to another Liferay version, the main advantage of changing the core via a hook is, that those changes don't need to be done again. The hook can be deployed in the new Liferay version and the core will be overwritten with the hook. (Liferay, 2011a)

Liferay Core Technologies

Liferays' Core technologies can be separated into 'Frontend', 'Business Layer', 'Database Access' and 'Development'. Describing the 'Frontend', Struts, Tiles, Taglibs and Javascript needs to be mentioned. Most Liferay portlets are developed using Struts through a custom bridge for portlets called StrutsPortlet. According to taglibs, the standard JSTL library is mainly used for tags. Liferay is built on Alloy UI but also offers the jQuery API and included jQuery Plugins to JavaScript code inside any portlet run within Liferay. For the 'Business Layer', Liferay uses Spring for dynamic proxy features. In case of 'Database Access', Hibernate is used in most situations, JDBC is used directly to perform custom

queries and SQL then, when using JDBC instead of Hibernate. Ant, Java, Tomcat and MySQL are used for the development of Liferay's core. Liferay portal (6.0 and above) supports six different types of out-of-the-box plugins (portlets, themes, layout templates, webs, hooks, and ext). The focus of this work was on the implementation and use of portlets and hooks. (Liferay, 2011a)

Administration Kernel

The Administration Kernel provides the base framework for integration and support of all modules, with tooling support, wizards, service providers, listeners and runtime configuration parameters. The services builder provides the basic framework to construct and deploy the services using a Model Driven Development (MDD) approach. The portlet plug-in leverages on the portlet bridge to provide dynamically generated portlets to the end users and enhanced Rich Internet Application (RIA) integration. The hooks plug-in provide convenient access to intercept and alter the services and functionality of the Liferay instance. By leveraging on all the services and features extended by Liferay, a robust Enterprise Services layer resides on top of his providing extended solutions ranging from portal management, web content management, enterprise content management, document management, user management, workflow management and security management. These in turn provide features such as personalization, collaboration, virtualization, social networking and integrates dynamic delivery channels and tunneling services. (Liferay, 2011a)

6.2.2 Liferay's Portal Organisation

The concept Liferay uses to organise the portal is that portals are accessed by users, which can be collected into user groups and can belong to organizations. Organizations can be grouped into hierarchies and users, user groups and organizations can belong to communities that have a common interest. Within an organization or a community, an user can belong to a team, which is a grouping of users for specific functions within a community or organization. An user can be a member of a role and a team within an organization or a community, and an user can be a member of roles and user groups within the whole portal. Roles are used to define permissions, as illustrated in figure 6.2, across the portal, across an organization or a community. Therefore portal roles, organization roles and community roles are available, which define the scope of a role. Roles are defined for portal security to determine which user has access to which resources. (Liferay, 2011b)

User represents the physical user of the portal, who has an account that the user uses to log into the portal and offers the user an own set of personal pages within the portal. User Groups are collections of users, they do have page templates which can be used to customize the personal pages of a user. Organizations are hierarchical collections of users to show where a user belongs in a particular hierarchy. Communities are collections of users who have common interests and they can be open, restricted or hidden in relation to the access authorization of an user. Teams are unique sets of users within the context

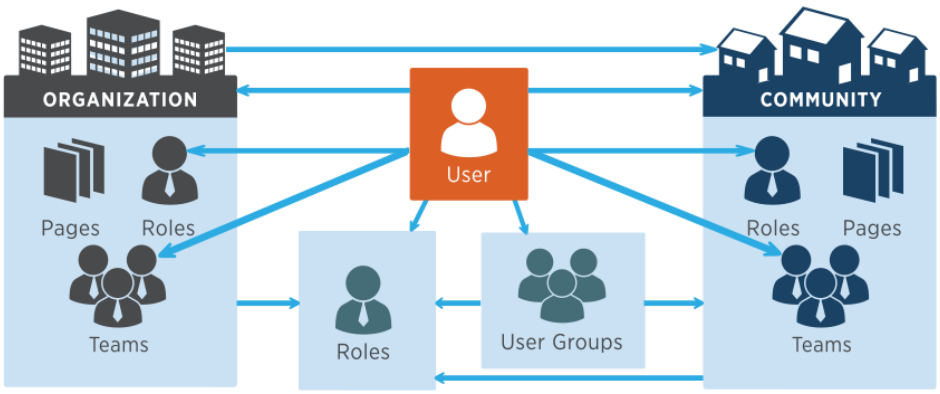


Figure 6.2: Liferay permissions model (Liferay, 2011a)

of a community or an organization. (Liferay, 2011a)

Page Structure

A portal page runs a portlet container that embeds several portlets and each portlet has its own decoration and controls, as shown in figure 6.3.

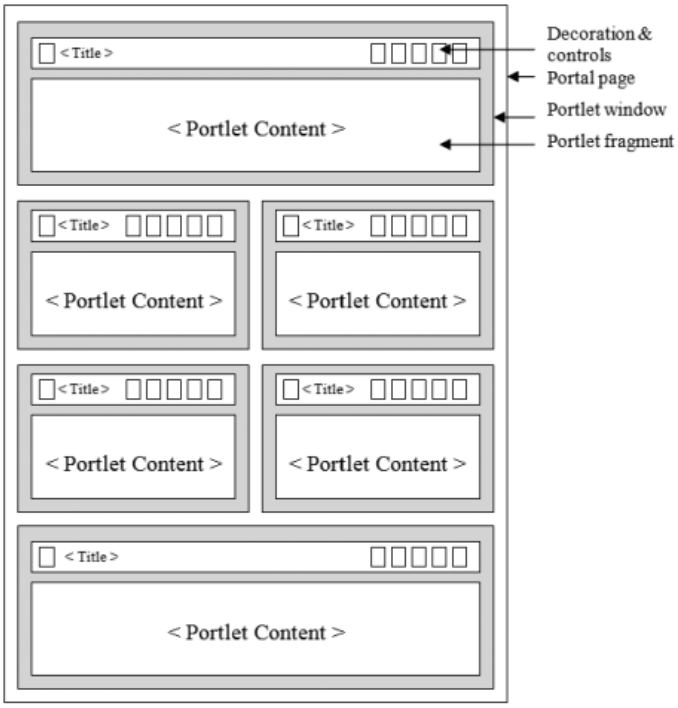


Figure 6.3: Structure of a portal page (Sarang, 2009)

Portlets can be customised using those controls. Permissions can be set for each individual

portlet if necessary, so that just a designated user is allowed to use the corresponding portlet. Data can be imported and exported as well. The look of every portlet, like color and text style, can be changed easily and even the location of each portlet on the displayed page can be customised. Custom layouts of the page can be created as well and applied to the page. Portlets can communicate with other portlets on the same page. (Sarang, 2009)

Figure 6.4 illustrates, which activities take place in the portal server and container.

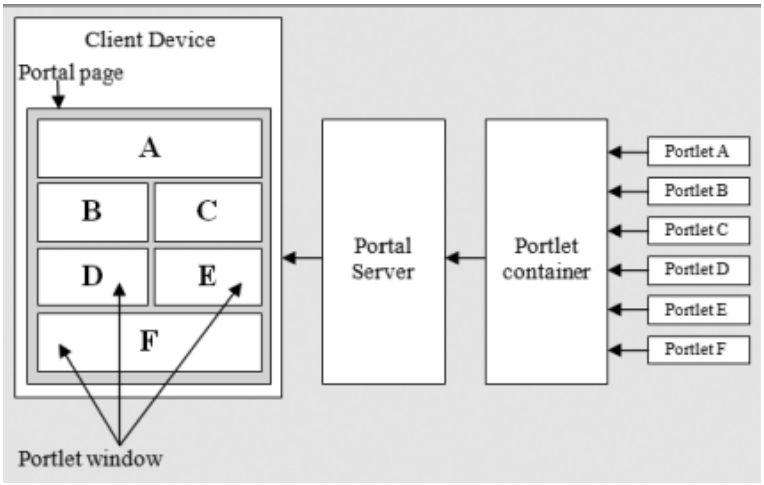


Figure 6.4: Create a portal page (Sarang, 2009)

Each single portlet generates the content for the user. Depending on the portlet application, the contents are static or dynamically generated. The container receives the portlet-generated contents and the portal server creates the portal page. During the page creation, the portal server applies the designated page layouts to place each portlet at the appropriate location. After the creation the server sends the page to the browser (client), which is then displayed to the user. (Sarang, 2009)

All sets of pages within the portal are divided into two types of pages: public and private pages. Public pages are accessible to everyone. Private pages are only accessible by a user if the pages belong to the set of private pages of a user or the user is member of a community to which the private pages belong, as pointed out in Boruta et al. (2011).

Request Handling

The actions that take place in the portal server, portlet container and portlets in response to an user request are presented in figure 6.5. Sarang (2009) stated the example of a portal page which contains three portlets A, B and C. The user initiates an action on the page so that the contents of the portlets need to be modified.erwÃ¤hnt

1. The user clicks on the portal page and therefore requests a data update.
2. This user request generates an action event on the portal server.
3. The portal server generates an event on the portlet container.

4. The container determines the update of the portlets, triggered by the user request.
5. Portlet A performs the requested action and returns the result to the container.
6. The container requests an Action to portlet C.
7. Portlet C performs the requested action and returns the result to the container.
8. The Action phase of the user request is completed and the container has all the data needed for rendering the user page.
9. The rendering phase starts.
10. The container fires a Render event to the portlets, sequentially or in parallel.
11. The container gathers the responses of the portlets.
12. The container returns the updated page to the portal server.
13. The portal server displays the portal page on the browser.
14. The user request is fully processed.
15. The portal server waits for further interaction from the user.

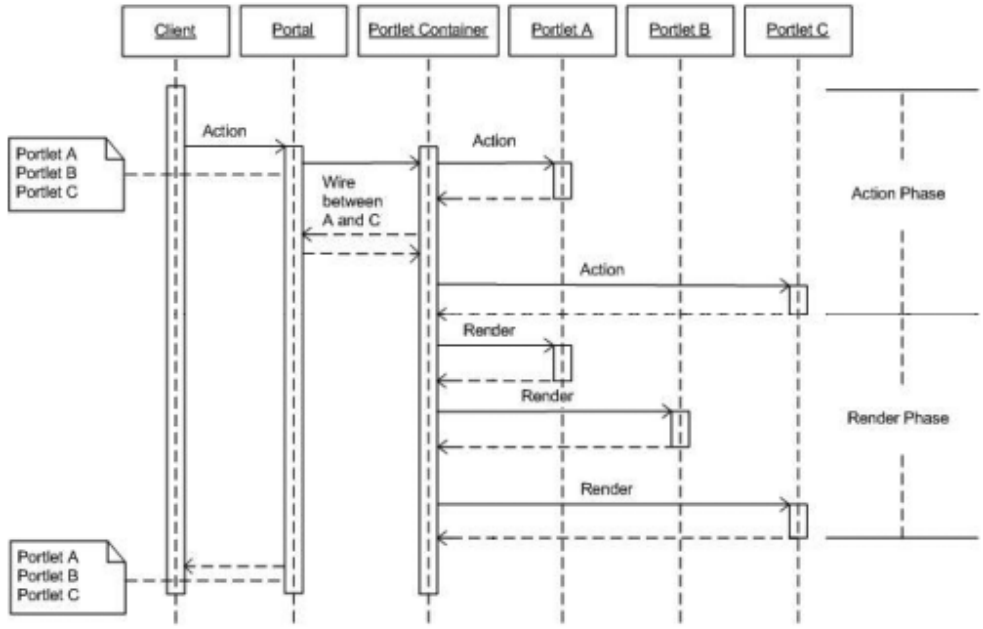


Figure 6.5: User request - sequence diagram (Sarang, 2009)

6.2.3 Liferay Portal Configuration

The extension environment (Ext) was used in previous versions of Liferay (e.g. Liferay 5.2) and has the same directory structure as Liferay portal itself and is implemented by overriding the existing source files by placing them in the same path. So the customised

code overrides the portal source code within the Ext, which can be explained that the custom code and the portal source code construct a customised portal within the Ext, which then gets deployed to the application server, as illustrated in figure 6.6 as derived from Yuan (2009).

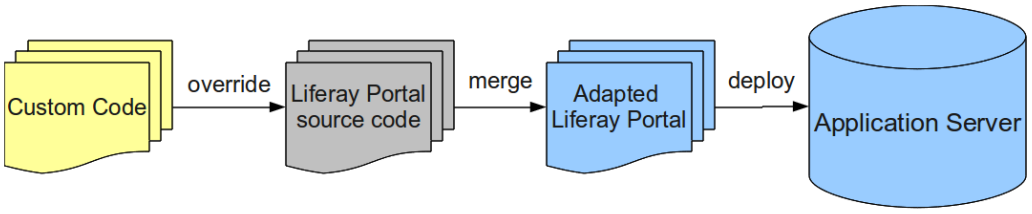


Figure 6.6: Liferay extension environment

Extending and configuring Liferay is possible by the use of the Plugins SDK environment or by modifying the portal source code. But just the Plugins SDK environment should be used for developing within the portal. One reason for that is, if the upgrade to newer version is planned, it won't be a problem using the SDK for developing. If changes are made directly in the portals code, they would be overwritten by upgrading Liferay.

The hot deployable Plugins SDK, which is the development strategy from Liferay 6 and up, provides a number of wizards to construct portlets, themes, layouts and hooks or interceptors, and provides an ext-plugin which provides a similar offset by only replicating those files that require modification without the entire portal content. The Ant target 'deploy' is used from Web application ARchive (WAR) and copy this WAR-file to the 'Auto Deploy' directory of the application server. Liferay with the application server detects the WAR-file in the auto hot-deploy folder of the portal and automatically extracts the WAR-file into the deployment folder of the applications server, as described in figure 6.7 derived from Yuan (2009). (Liferay, 2011a)

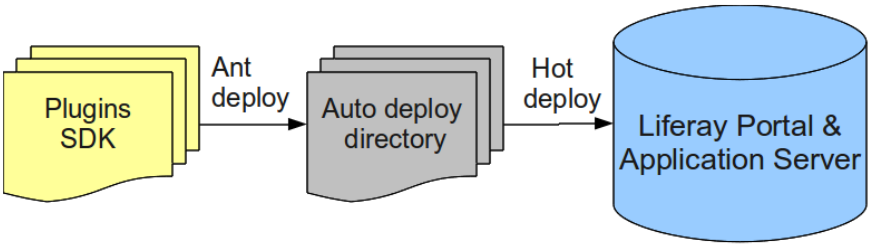


Figure 6.7: Plugins SDK environment

Ext plugins allow using internal APIs or overwriting files of the Liferay core as well. Ext plugins require the server to get restarted after e.g. creating new portlets or adapt existing ones. After the restart new or changes plugins can be deployed to the application server. The Plugin approach provides both an IDE and command line interface. The IDE takes a wizard approach to create portlets, themes, layouts and hooks. The hooks are basically interceptors that can be categorized into model hooks, JSP hooks, properties hook, event

hooks. Model hooks deal with interception of entity actions in services, JSP hooks are provided to dynamically modify Liferay JSP pages, the event hook is used to intercept portal events, property hook is used to update the Liferay properties. The ext-hook plugin is a new feature that provides changes to the Liferay structure and can be hot deployed at runtime. When *portal.properties* can't be customised with a hook plugin, it is possible to customise those properties with the Ext plugin. (Liferay, 2011a)

6.3 Prototype Development Environment

The set up of the development environment and the installation of Liferay are described in the appendix.

Overriding the properties of the portals' configuration files, can be done through the files *portal-ext.properties* and *system-ext.properties* which need to be created and stored in the classpath.

6.3.1 portal.properties

The portal.properties file contains the main configurations for a Liferay portal. This file is placed in the source of the portal, as shown in listing 6.1.

```
~/TU/DA/Liferay/liferay-portal-src-6.0.6/portal-impl/classes
```

Listing 6.1: portal.properties file

Changes of the portals core are performed using the *portal-ext.properties* file (see listing 6.2), which need to be created after a new Liferay installation.

```
include-and-override=portal-ext.properties
include-and-override=${liferay.home}/portal-ext.properties
```

Listing 6.2: portal.ext. properties file

The portal-ext.properties file overrides default properties that come with Liferay.

portal-ext.properties

Pointing the Liferay bundle to the database and changing the settings of the portal can be done by configuring the portal-ext.properties file or by logging in to the portal and change the settings in the control panel. The advantage of using the control panel for configuring instead of change the settings with portal-ext-properties file is, e.g. when configuring the LDAP settings is be done by using the Control Panel, the settings will get stored in the database, that's easy and no restart of Liferay is required. When a change is made in the portal-ext.properties file, a restart of the tomcat server is required. Also many configuration tasks can be performed through Liferay's portlet-driven user interface.

The file needs to be placed in the classpath of the application server, as illustrated in listing 6.3.

```
~/TU/DA/Liferay/liferay-portal-6.0.6/tomcat-6.0.29/webapps/ROOT/WEB-INF/classes$
```

Listing 6.3: Classpath of the application server

Database Configuration

The configuration of the database is set in the portal-ext.properties for all application servers. To set up MySQL, the lines presented in listing 6.4 need to be added to the portal.properties-file.

```
#
#--------------------MySQL
#
jdbc.default.driverClassName=com.mysql.jdbc.Driver
jdbc.default.url=jdbc:mysql://localhost/lportal?useUnicode=true&characterEncoding=UTF
    -8&useFastDateParsing=falseault User Login
jdbc.default.username=liferay
jdbc.default.password=liferay
schema.run.enabled=true
schema.run.minimal=true
```

Listing 6.4: Database configuration

E-Mail Notifications

Every added user gets automated e-mail notifications from the portal, according to the account creation, reset passwords, updated discussion entries and much more. A Gmail account was used for the portals' administrator account. To e.g. send notifications to users via the administrator e-mail address, see the following lines of the portal-ext.properties file, as shown in listing 6.5.

```
#
#--------------------MAIL SESSION
#
mail.session.mail.pop3.host=pop.gmail.com
mail.session.mail.pop3.password=
maÂil.session.mail.pop3.port=110
mail.session.mail.pop3.user=
mail.session.mail.imap.Âhost=imap.gmail.com
mail.session.mail.imap.port=993
mail.session.mail.store.protocÂol=imap
mail.session.mail.transport.protocol=smtp
mail.session.mail.smtp.host=smtp.gmail.com
mail.session.mail.smtp.password=tool2011
mail.session.mail.smtp.user=lifelearning2011@gmail.com
mail.session.mail.smtp.port=465
mail.session.mail.smtp.auth=true
mail.session.mail.smtp.starttls.enable=true
mail.session.mail.smtp.socketFactory.class=javax.net.ssl.SSLSocketFactory
```

Listing 6.5: E-mail notifications

As already mentioned, those settings could also be changed using to go to the Control Panel - Portal Settings - Email notification and edit there.

Default User Login

An user gets per default the role user, is a member of the user group ProtoLife (personal pages) and is assigned to the community English - Language Learning and Training. This can be realised by adding three lines of code to the portal.properties-file, as presented in listing 6.6.

```
#
#--------------------DEFAULT USER LOGIN
#
admin.default.role.names=User
admin.default.user.group.names=ProtoLife
admin.default.group.names=English Language Learning and Training
```

Listing 6.6: Default user login

Modify User Accounts

To modify the forms displayed to an existing user while reviewing the users' account and deny an user to modify the personal pages, the lines shown in listing 6.7 were added to the portal-ext.properties file.

```
#
#--------------------MODIFY USERACCOUNTS
#

#
# Remove links from My Account in Control Panel and portlet, just display following to
    the user
#
users.form.add.main=details, password, communities, roles, user-groups
users.form.update.main=details, password, communities,roles, user-groups
users.form.update.identification=addresses,websites,social-network
users.form.update.miscellaneous=display-settings
users.form.my.account.main=details,password,communities,roles
users.form.my.account.identification=addresses,websites,social-lst:openofficenetwork
users.form.my.account.miscellaneous=display-settings

#
# user is not allowed to modify personal pages
#
layout.user.private.layouts.modifiable=false
layout.user.public.layouts.modifiable=false
```

Listing 6.7: Modify user account display settings and deny modification of personal pages

6.3.2 Integrate Open Office

Following this steps on the corresponding Wiki page[2] and outlined in listing 6.8 make it possible to use Open Office within the portal and enables conversions of Web content to doc, odt, pdf, rtf, sxw and txt.

```
stefi@stefi-XPS-L701X:~$ cd /etc/openoffice/

stefi@stefi-XPS-L701X:/etc/openoffice$ soffice -headless -accept="socket,host
    =127.0.0.1,port=8100;urp;"
```

Listing 6.8: Integrate Open Office

In the appendix the development environment (see B.1) and the installation (see B.2) of the prototype are described in detail.

6.4 Prototype Development Details

The Liferay Community Edition 6.0.6 was chosen for the prototype implementation, the whole installation and start-up process is described in B.2. Figure 6.8 gives an overview over the architecture of the implemented E-Learning prototype, which has been derived from Yuan (2010) .

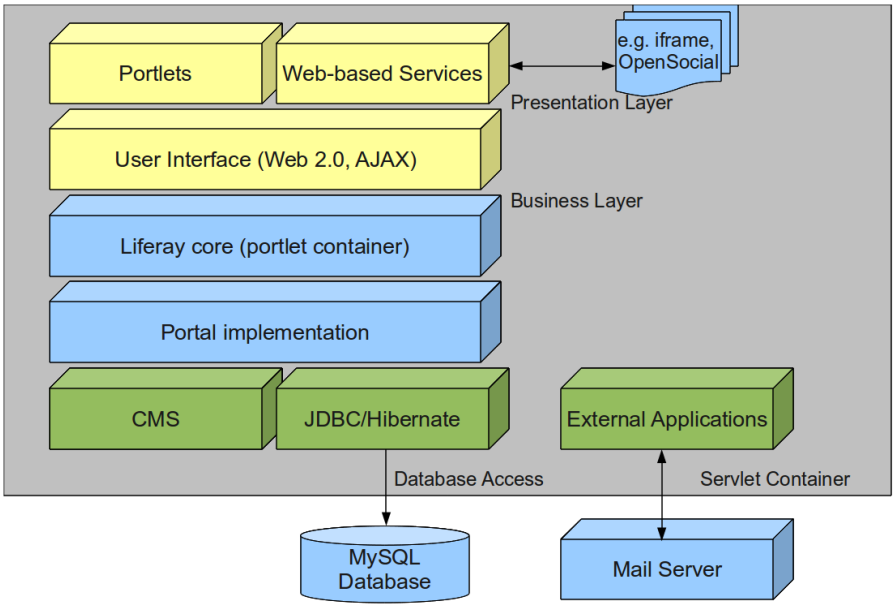


Figure 6.8: Architecture of the prototype

Using portlets, new and pre-existing functionality can be added to the learning prototype. In most cases AJAX is used for the communication between the browser and the server.

[2] http://www.liferay.com/community/wiki/-/wiki/Main/Document+Conversion+with+OpenOffice;jsessionid=04575BD08967128916EBB1C45416FD74.node-2

The portlet container manages the lifecycle of the portlets. Spring and hibernate is used for persistence. Further the architecture provides a service builder which generates low level code to store resources in the database.

Liferay was used as a mashup platform, as there are many sites providing their contents as widgets and gadgets and the learning environment was configured, to combine existing contents and applications within one learning environment.

The control panel, as detailed described in the next chapter, is used for most administrative tasks, like administer users, create portal structure or implement security. When using the control panel an administrator is able to make changes to the administrators account, add, modify and delete users, communities, user groups, roles, password policies, site templates and much more. The language learning prototype is organised in different views or pages providing several selected portlets.

The administrator can, via accessing the control panel, set the global server settings (as illustrated in figure 6.9), define notifications, set authentication policies and much more using the control panel.

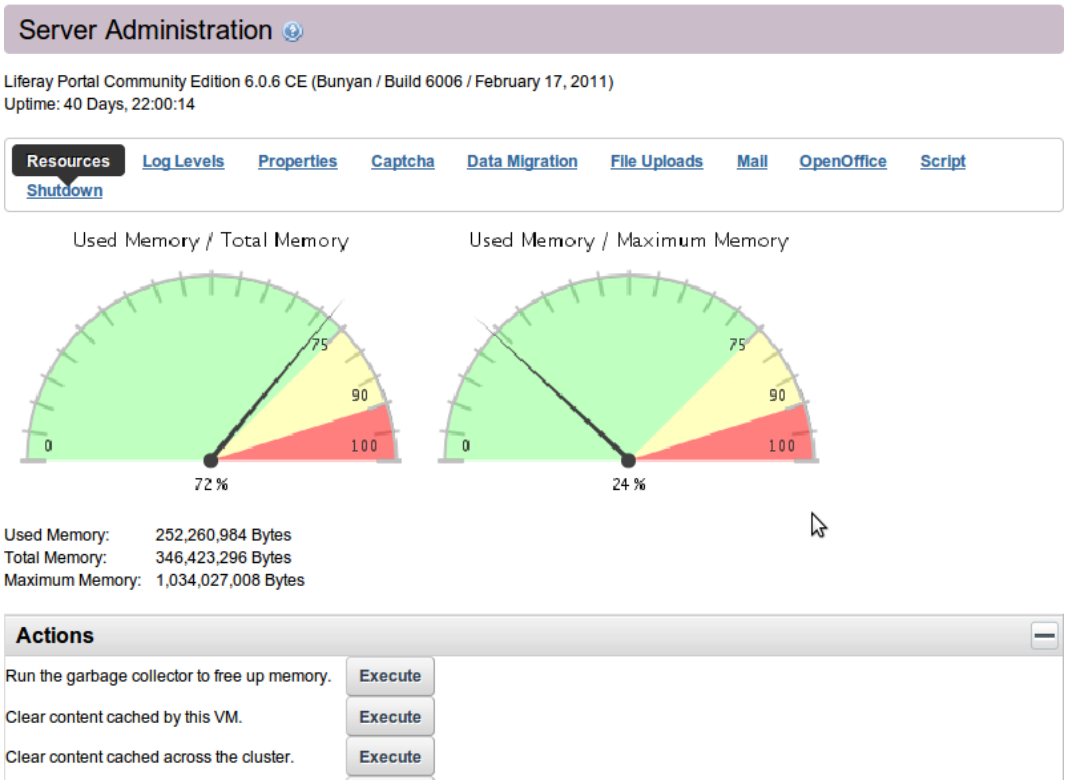


Figure 6.9: Prototype server administration

Liferay is designed to deploy portlets to the Portlet API (JSR-168). Many portlets are bundled with the portal (to give a few examples, Mail, Document Library, Calendar, Message Boards) and can be used for custom portlets as well.

The big advantages a portal brings with it are not just content aggregation and layout

customisation. The Liferay portal offers collaboration among user communities and therefore as a portal designer it is pretty easy to create different content for different user or communities.

The publication of Boruta et al. (2011) describes detailed, that user groups and communities, presented in section 6.2.2 as well, have been used for organising the E-Learning prototype. In this context it is very important to mention site templates, as they were used in the context of user groups and communities. Site templates make it possible to create web sites within communities or user groups by selecting from pre-defined templates. The set of personal pages of every user and also of every community within the portal is realised with different site templates. The site template in figure 6.10a is used for organising every new communities within the learning environment. The role of an user can only be modified by an administrator through the control panel, as illustrated in figure 6.10b.

(a) Sitetemplate for classrooms

(b) Edit and define permissions for a certain role

Figure 6.10: Control panel activities

Communities can be seen as a classroom in a school and need to be set up by the administrator. Within such a classroom community, there can exist one or more users assigned the teacher role and students, which just have the portal role 'User'. A classroom is a restricted community and has only private pages, which means that a member of the classroom is not able to view any content of a classrooms' web pages. As soon as a new community classroom is created, the same set of pages, realised using the templates, is copied to the classroom pages. A classroom only has private pages, as there is no need to have public pages. Unless the administrator of a classroom, which will often be the teacher, decides to create a public page of the classroom. This public page would be accessible to everyone using the learning environment.

After a user creates an account, the set of pages of the user group site template will be copied to the personal pages of the user. When an user is assigned to a community the user has access to all community pages through the user interface. Several site templates have been created for structuring the prototype.

NOTE: The creation of pages, communities, roles and all according handling of the portal instance and general settings can be looked up using Liferay's User Guide, Liferay Developer Guide and Liferay's Administrator Guide, available on the Liferay's website[3].

6.4.1 Prototype Roles and Permissions

The permissions for accessing resources within the portal are organised using defined roles. Figure 6.11 shows the user management within the portal.

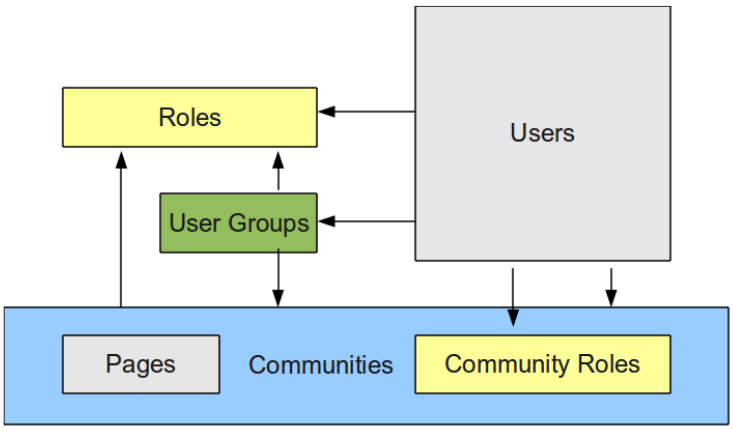


Figure 6.11: Portal user and permission management

The Administrator has full control over the whole portal with all its functionalities, users and contents. The portal role User is the default role that has the permission to see all content in the portal and communities the user is a member of. To enable users to initiate and organise learning communities, the specific user role Community_Manager must be assigned. This roles grants users such privileges to manage self-organised learning groups. The portal role Classroom_Teacher defines extended permissions for a teacher who is using the environment, which offers this user to organise selected content in restricted areas, configure various content and portlets. Those configurable portlets can be identified by a wrench in the upper right corner of the respective portlet.

The portal role Teacher_Admin allows an user to create, manage and even delete certain communities within the learning environment.

	Has the rights to	**Is not allowed to**
Administrator:	configure and edit the learning environment (pages, users, content, security, server settings)	-

[3] `http://www.liferay.com/documentation/liferay-portal/`

	Has the rights to	**Is not allowed to**
User:	is allowed to see the content within the learning environment	manage or edit any content, page or user; cannot access the control panel
Community_Manager:	initiate and organise learning communities for self-organised learning groups; has the permission to add and configure selected portlets to pages	manage users (add or delete users and assign roles)
Classroom_Teacher:	access the restricted teacher area within a classroom; assign members to a classroom and can configure selected portlets	create, edit or delete communities
Teacher_Admin:	similar to Community_Manager, allowed to create communites and manage their pages, assign members	assign users with certain roles

Table 6.1: Prototype roles and description

To reach this behaviour it was necessary to overwrite a jsp-file in the source code of the portal using the protolife-hook, which already has been described in section 6.4.3.

6.4.2 Prototype Portlets

As described in section 6.2.1, portlets comprise the core functionality of the portal system. Every portlet can be customised to meet the required functionality. So for every single portlet the look can be changed and also e.g. the access restrictions can be set. Using the controls it can be set, that just selected users are allowed to. The following listed portlets separated into five categories were used and combined while implementing the prototype.

The web content management are tools to manage structured and unstructured content to be published on a web site.

	Content Management System portlets
Web content	main management interface for creating, editing and publishing web content on a page
Web content search	users can search the web content of a site

	Content Management System portlets
Asset publisher	any type of content can be published through the asset publisher, as it were web content
Document library	for document management (upload, display, versioning)
Image gallery	images can be managed and organised with this portlet (upload, display)
Navigation	displays the whole portal structure with all existing pages
Nested portlets	drag and drop of portlets into other portlets, to create more complex page layouts
Site map	displays the structured directory of links to all pages, so a navigation to every page within the portal is possible by a single click
Page Ratings	users can rate a page (quality of content, looking of personal page)
Directory	users can search for other users, organisations or user groups
Sign In	users can sign in to the portal, create an account or ask for the password, in case the existing user has forgotten it

Table 6.2: Liferay CMS portlets

The collaboration tools are a robust suite of collaboration applications for building communities of users within the portal.

	Collaboration Tools portlets
Calendar	a complete calendar solution; scheduling events, shared calendar, alarm via email, import and export of calendars; three configuration options: Email From, Event Reminder Email and Display Settings
Chat	allows users to send and receive instant messages, when a user is logged in to the portal; settings can be changed by the user
Mail	can be used to integrate a users mail within the portal
Message boards	a state of the art forum application, which has a lot of configuration options
Wiki	a fully-featured wiki application to collaborate on information
Invitation portlet	user can invite users to a portal page (referring mechanism)
Web form	is placed on a page and users can fill in the form, which is then send to the configured e-mail address (e.g. feedback form)

Table 6.3: Liferay collaboration portlets

Social features enable the social interactions within the portal.

	Social Networking Tools portlets
Wall	user can post messages on pages of other users, but users must be friends within the portal
Summary	placed on a user page it displays the user an overview over his profile
Activities	displays user activities portal wide (posts on message boards, wiki entries)
Members	displays which users are members of a certain community or organisation
Search and invite friends	to search within the users of a portal and invite the certain user to be friends within the portal

Table 6.4: Liferay social networking portlets

Existing widgets were integrated by using OpenSocial gadget and the 'iFrame' portlet. Liferay features an OpenSocial container bases on Shiding. Therefore it is just necessary to place the gadget URL into the gadget container provided by Liferay. This can be easily done using the control panel → content → OpenSocial → Add Gadget. Using the 'iFrame' portlet just the URL of the Web-based service need to be copied to the source field within the configuration field of the 'iFrame' portlet. This can be done after the portlet is added to the Web page by clicking on the wrench which is placed on the right upper corner of the portlet → Configuration → Source URL → Save.

	Reusing existing web applications
iFrame	to embed other HTML pages to a designated portal page
OpenSocial	gadgets can be embedded on a page, so it is a wrapper for applications

Table 6.5: iFrame portlet and OpenSocial Gadget

Liferays' community plug-ins[4] is an online repository of files and add-ons to the core Liferay technology contributed by the Liferay community.

[4] `http://www.liferay.com/downloads/liferay-portal/community-plugins`

	Community Plugins
Group notification	to send an email to all group or community members
List	lists with according tasks can be created within a page
Display video	render videos from Youtube, Vimeo, DailyMotion, Revver and SevenLoad

Table 6.6: Liferay portal community plugins

Integrated, Adapted and Implemented Portlets

The following existing widgets and gadgets were either integrated in the prototype using OpenSocial Gadget and 'iFrame' portlet.

	Integrated widgets and gadgets
Cambridge Online Dictionary	is embedded in the prototype using the OpenSocial Gadget and looks up definitions of terms and words
Lab Pixies TODO lists	those lists are copied to every users personal pages and are integrated using the OpenSocial Gadget
Google To Do List	those lists are integrated using the OpenSocial Gadget and can be used as an alternative to the Lab Pixies TODO lists
Reference Box: Translator	translates the placed text from any language to any selected language. Further it offers the possibilities to count the inserted words, change the case of the inserted text or to reorder it. It is integrated into the system using the 'iFrame' portlet.
Cambridge dictionary and thesaurus	looks up the definition or synonym of an entered word and is integrated into the portal using the OpenSocial Gadget.
The lingro Dictionary	is a tool where a Web site address can be entered and all words on that Web site are made clickable and the definition of every word can be looked up. It is embedded into the prototype using the 'iFrame' portlet.
Spell checker	is a widget with is embedded in the learning prototype using the 'iFrame' portlet. Any text can be placed into the text box and the spelling will be checked.
English Dictionary	this Google gadget is integrated to the prototype using OpenSocial. Words can be looked up by placing them in the text box.
text2speech	is integrated to the prototype using the 'iFrame' portlet as well. Text can be entered into the text box, a voice needs to be chosen and a downloadable mp3 file is the result of this feature.
TitanPad	is added to the prototype for real time collaboration. Using this tool, users can write together within one text box, the TitanPad, and can correct each other. This tool is also integrated into the prototype using the 'iFrame' portlet.

	Integrated widgets and gadgets
Benchmark business trainer	is integrated using the 'iFrame' portlet and offers some vocabulary training sessions.
English365	is integrated using the 'iFrame' portlet and offers various English training sections.
face2face vocabulary trainer	is also integrated using the 'iFrame' portlet and offers elementary vocabulary training.
English games	all available English games within the prototype environment are integrated using the 'iFrame' portlet.

Table 6.7: Integrated functionality using the OpenSocial Gadget and the iFrame portlet

The following portlets were adapted or implemented for the prototype.

	Adapted and implemented portlets
Search and invite friends (community portlet)	has been adopted to be compatible with the used platform version.
Display video (community portlet)	has been adjusted according the requirements.
Chat	needed to get adapted, so that just users who are friends are allowed to chat with each other (realised using a buddy-list).
Cambridges' Double-click dictionary search	to enrich the learning platform with domain specific functionalities and features this portlet has been implemented.

Table 6.8: Liferay portal community plugins used within the E-Learning environment

A more detailed description of the above mention portlets is following below.

Search and invite friends

The by the community provided 'search and invite friends' portlet didn't work at all. After a while of searching through forums and wikis, the reason could be found. This portlet needs jquery, but this circumstance wasn't considered in the code. Therefore it was necessary to include the line presented in listing 6.9.

```
<script type="text/javascript" src="/html/js/jquery/jquery.js"></script>
```

Listing 6.9: jquery

Further a signal box was missing for successful friend request so this was added in the code to, as illustrated in listing 6.10.

```
<%— Stefanie Boruta, 2011-07-10, add jquery.js otherwise portlet not working and added
     an alert —%>
<script type="text/javascript" src="/html/js/jquery/jquery.js"></script>
<script language="javascript">
function addFriend(addFriendUrl) {
  jQuery.ajax(
    {
      url: addFriendUrl,
      success: function(message) {
      alert\ding{213}("Friendship request has been sent!");
        Liferay.Popup(
          {
            width: 550,
            modal: true,
            title: Liferay.Language.get('add-as-friend'),
            message: message
          }
        );
      }
    }
  );
}
```

Listing 6.10: Search and invite friends portlet

Chat

Per default Liferays 'chat' portlet shows all online users, which is not the expected behaviour. Within the learning environment not every user should be able to chat with ever other user within the environment. Therefore the portlet.properties of the 'chat' portlet needed to be adapted to the needs of the prototype, as shown in listing 6.11. The portlet.properties file can be found by following the link application server → webapps → chat-portlet → WEB-INF → classes → portlet.properties. To get an idea what this properties file looks like it is printed below.

```
#
# chats are just possible with friends, not with every member of the portal
#

buddy.list.strategy=friends
```

Listing 6.11: Chat portlet

Display video

To get the 'display video' portlet working, just a little change had to be made in the code. But to solve the problem took a while. Within the code, double quotes had to be replaced with single quotes, as presented in a small clipping of the code in listing 6.12. That is sometimes the whole miracle behind problems with portlets. Two signs in the view.jsp file of the 'display video' portlet needed to be substituted to get it work.

```
<%— Stefanie Boruta 2011-07-08, change allowFullScreen="<%= (enableFullscreen)?"true
    ":"false" %>" , because original is with double quotes which does not work —%>
```

```
    <liferay-ui:flash
      allowFullScreen='<%= (enableFullscreen)?"true":"false" %>'
```

Listing 6.12: Display video portlet

Double-click dictionary search

This is an existing widget provided by Cambridge, but it was not possible to integrate it to the prototype using the OpenSocial container or the 'iFrame' portlet. So a portled needed to be implemented to connect the functionality of the widget to the prototype. To get an idea how the development environment using Eclipse looks like, figure 6.12 shows, how the structure of the 'Double-click dictionary search' portlet looks like.

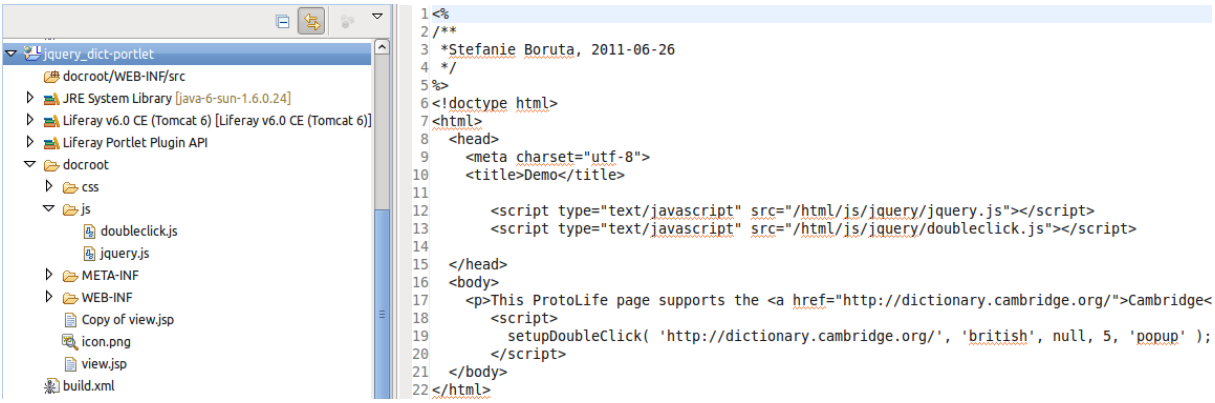


Figure 6.12: Double-click dictionary search portlet development

To give an example how a portlet looks like, see listing 6.13 where the jsp-code of the 'Double-click dictionary search' portlet is illustrated.

```
<!doctype html>
<html>
  <head>
    <meta charset="utf-8">
    <title>Demo</title>

       <script type="text/javascript" src="/html/js/jquery/jquery.js"></script>
       <script type="text/javascript" src="/html/js/jquery/doubleclick.js"></script>

  </head>
  <body>
    <p>This ProtoLife page supports the <a href="http://dictionary.cambridge.org/">
        Cambridge</a> double-click dictionary search! If you do not know a phrase or a
        word within the current site, highlight the phrase or double-click the desired
        word. After that the word "Definition" appears above the highlighted phrase/
        word in red colour. Click on "Definition" will open a new site with the
        Cambridge phrase definition of the phrase/word looked up by you.</p>
       <script>
         setupDoubleClick( 'http://dictionary.cambridge.org/', 'british', null, 5, '
             popup' );
       </script>
  </body>
</html>
```

Listing 6.13: Double-click dictionary portlet

6.4.3 Prototype Hooks

From Liferays' community plug-ins[5], the login landingpage hook was integrated to redirect an user after login to the right landing page (private pages).

Further a protolife hook for overwriting some core functionality and selected pre-existing portlets has been implemented: the display of the 'directory' portlet, 'user details' portlet and the contents of form for the 'log in' portlet as well as the behaviour, that a normal user isn't able to access the control panel was realised with this hook. A manual for creating such a Liferay hook can be looked up at the associated Wiki page[6].

To give an example, the implemented dockbar hook which denies a normal user or learner the access to the control panel, is shown in listing 6.14. Therefore it is necessary to overwrite the view.jsp file of the dockbar placed in application server → webapps → ROOT → html → portlet → dockbar → view.jsp. Figure 6.13 illustrates the look within the nautilus.

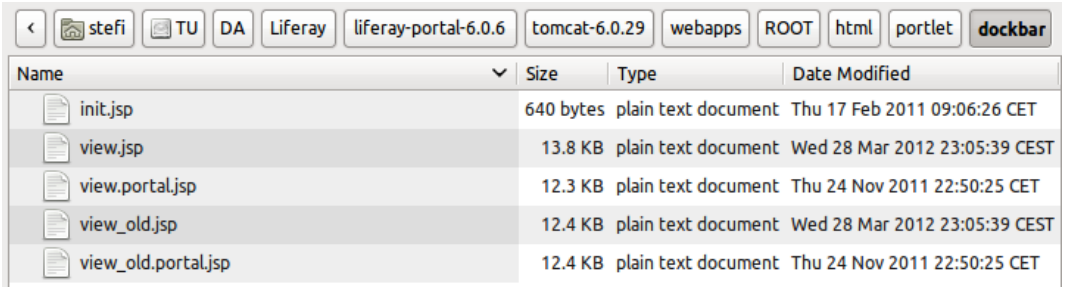


Figure 6.13: Dockbar path within nautilus

```
...
boolean userIsAdmin = false;

for (Role role : user.getRoles()) {
    if (role.getName().equals("Administrator"))
       userIsAdmin = true;
    else if (role.getName().equals("Teacher_Admin"))
       userIsAdmin = true;
    else if (role.getName().equals("Community_Manager"))
       userIsAdmin = true;
    else if (role.getName().equals("Classroom_Teacher"))
       userIsAdmin = true;
}

boolean showPin = false;

...

 <%-- link in dockbar to control panel for role administrator only --%>
    <c:if test="<%= userIsAdmin %>">
      <span class="user-links <%= themeDisplay.isImpersonated() ? "menu-button": ""
          %>">
...
```

[5] http://www.liferay.com/downloads/liferay-portal/community-plugins

[6] http://www.liferay.com/documentation/liferay-portal/6.0/development/-/ai/overriding-a-jsp

```
  <%-- NO link in dockbar to control panel for every role except administrator --%>
      <c:if test="<%= ! userIsAdmin %>">
      <span class="user-links <%= themeDisplay.isImpersonated() ? "menu-button": ""
          %>">
...
```

Listing 6.14: Dockbar hook

6.4.4 Deploying of a Portlet or a Hook

Liferay provides a mechanism called autodeploy that makes deploying portlets or any other plugin type easy. The WAR file needs to be dropped into the deploy directory of the application server. A second opportunity would be using Ant deploy within the command line.

6.4.5 Overwrite Portal Notifications

Portal notifications for mails (.tmpl) have been created and exported into a .jar-file which got deployed on the application server. To give an example, the notification template which is send after a user creates an account within the portal is illustrated below.

```
Dear [$TO_NAME$],<br /><br />

Welcome to ProtoLife! Your account at http://[$PORTAL_URL$] is ready to use.

Your password is [$USER_PASSWORD$]. Enjoy all the great features ProtoLife brings with
    it!<br /><br />

Sincerely,<br />
[$FROM_NAME$]<br />
[$FROM_ADDRESS$]<br />
http://[$PORTAL_URL$]<br />
```

Listing 6.15: Overwrite portal notifications

6.5 Conclusion

This section summarised the main statements regarding the implementation of the prototype using Liferay and certain technologies.

Liferay portal software

The Liferay community offers a Wiki, which serves as an information platform. It is possible to gain a lot of knowledge from the Wiki, but there are still many sections and parts that aren't filled at all. But as Liferay is a free and open-source software, the

information regarding developing and configuring the portal can be reported as good, even if some parts appear uncoordinated and confused. It is possible to post threads and also answer them as a registered user. But the big disadvantage is, that the response times are very long, if there is any response.

From the development point of view, as noted in Boruta et al. (2011), it can be reported that Liferay is a powerful platform but also has some bugs and it caused quite an effort to get them fixed or find workarounds. The documentation and forum is very helpful but there are still gaps according to detailed design, installation and configuration. The behaviour of some provided out-of-the-box portlets is quite unexpected and requires adoption and extra effort, which can be done by any experienced developer, who is familiar with the Liferay portal structure and source. Some portlets are just available for particular releases of Liferay, so it is necessary to preserve caution.

As Liferay is open-source and a huge bunch of source code, it gives a developer a pretty hard time to get around the huge amount of classes, functionalities and possibilities Liferay offers a developer. Through the mechanism of just overriding and not changing the portal source code it is protected anyway, which offers additional benefit.

Adding new or pre-existing services to the portal can be realised by writing new plugins, embed an existing service into the 'iFrame' portlet of Liferay or integrate it by using OpenSocial, which enables a more general inclusion of widgets. Like portlets, OpenSocial Gadgets are a standard way to develop applications for a portal environment. The administration of the prototype using the control panel is a comfortable solution, except creating new communities and adding users to according communities needs much time when it is done by hand.

The use of Liferay is not intuitive enough, to be able to configure and adapt the portal without reading the Administrator Guide, the Development Guide and search the Community forum.

Web 2.0 technologies

Web 2.0 technologies enable collaboration, communication and interaction between learners and teachers and may increase the motivation of learners as well. One problem of that is, that technologies or the use of certain technologies are never fault-proof. Native speakers probably won't have a big problem with that issue, but they can affect second language learners in a negative way.

Using pre-existing web 2.0 technologies may create a kind of dependency on the maintenance of the service, as those web 2.0 technologies and applications are used as a part of the learning environment. Countless web 2.0 tools are available on the web. However, it is a long and from time to time difficult process to find appropriate tools that can be combined with the prototype learning environment in an useful way. Further it is necessary to assure the performance within the portal of every integrated widget, gadget or application, to ensure satisfaction for the user.

Chapter 7

Functional Prototype in Operation Mode

This chapter describes the prototype functionality with screenshots, which present the user view within the learning environment. The structure of this chapter is separated into parts regarding the portal itself, the administrator, the teacher-view and learner-view. Finally selected tools provided by the prototype are presented more detailed.

7.1 Prototype Portal

Figure 7.1 shows the start page of the prototype, which is as well realised with a private community.

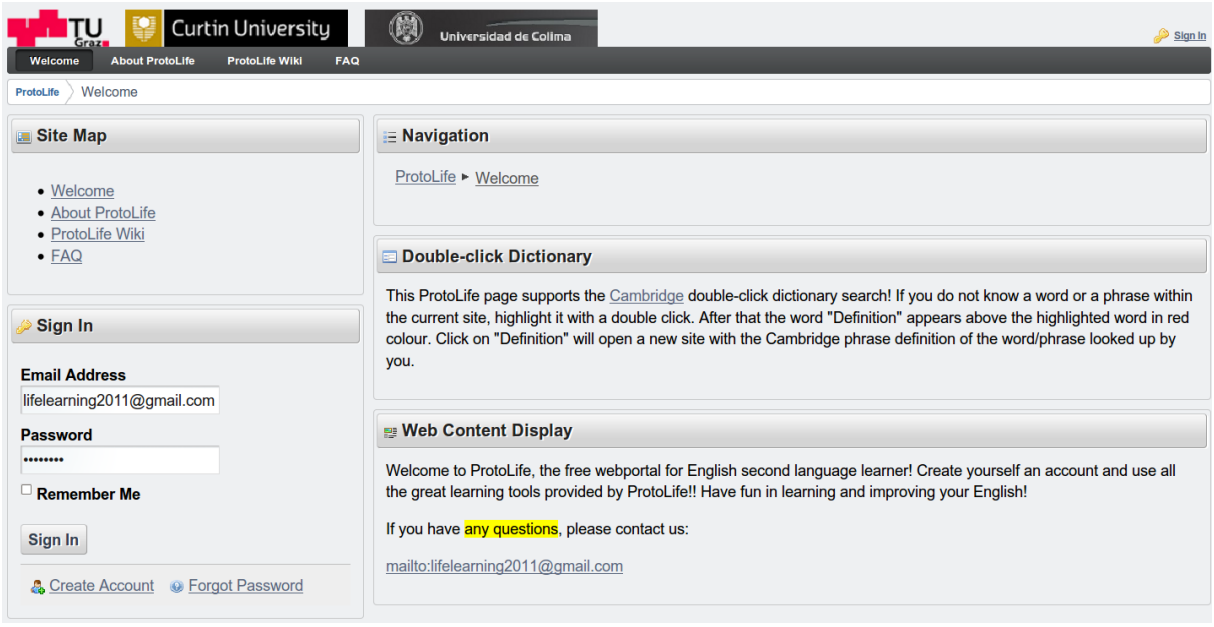


Figure 7.1: Prototype start page

The 'Welcome' web page consist of a 'site map' and 'navigation' portlet, which are showing the structure of the current accessed web pages, the 'sign in' portlet, where an existing user can sign in or a new account can be created, the 'double-click dictionary search' portlet, which opens per double-click on a word or phrase the definition of the desired word or phrase in a separated window and a 'web content display' portlet, which displays a welcome message and a contact option.

Further the Web pages 'About ProtoLife', 'ProtoLife Wiki' and 'FAQ' are reachable for any visitor of the main pages of the prototype. Those pages are accessible for every guest of the web site, who has the link to reach the prototype (URL).

Site Templates

Several site templates, as presented in figure 7.2 have been created for structuring the prototype. Furthermore an user group 'ProtoLife' has been created and every user is per default added to the user group. The site template ProtoLife_PUBLIC for public pages and the site template ProtoLife_PRIVATE for private pages were defined to pre-populate end users' personal pages.

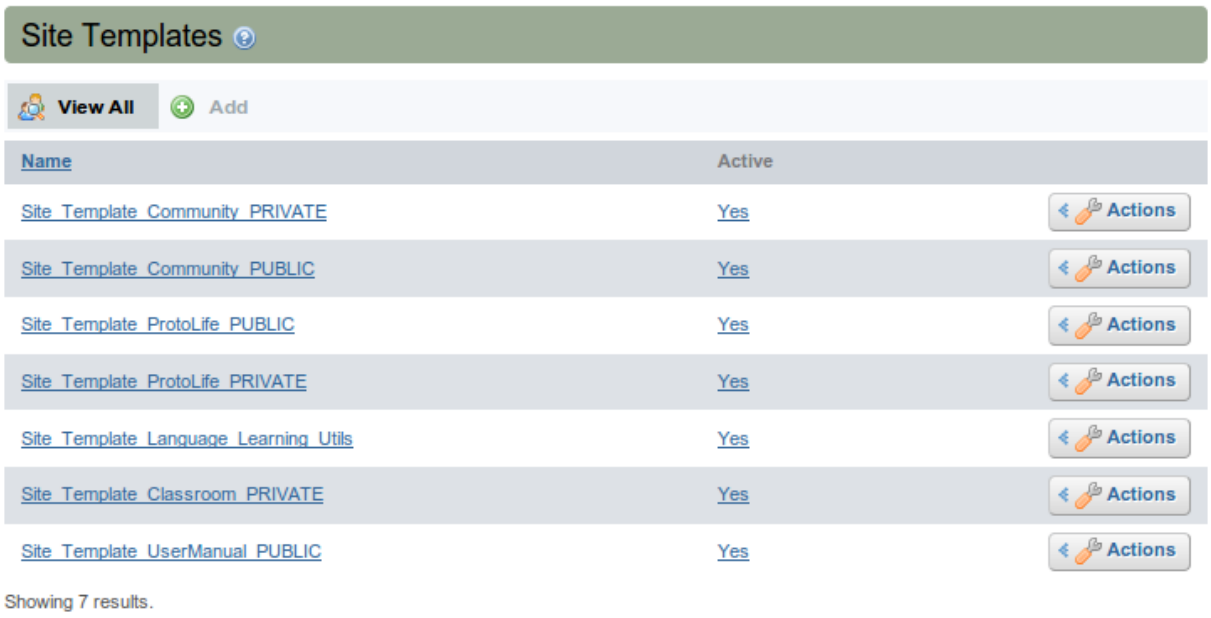


Figure 7.2: Site templates

The site template Community_PUBLIC and site template Community_PRIVATE are used for newly created communities with common interests, e.g. a community for academic writing. The site template Language_Learning_Utils is used for the community 'ENGLISH - second language learning and training', where every registered user is automatically subscribed to.

Users Log In

Every visitor of the prototype web page can create an account, see figure 7.3. The first name, last name, a screen name and a valid e-mail address need to be provided and the text verification field needs to be filled in correctly.

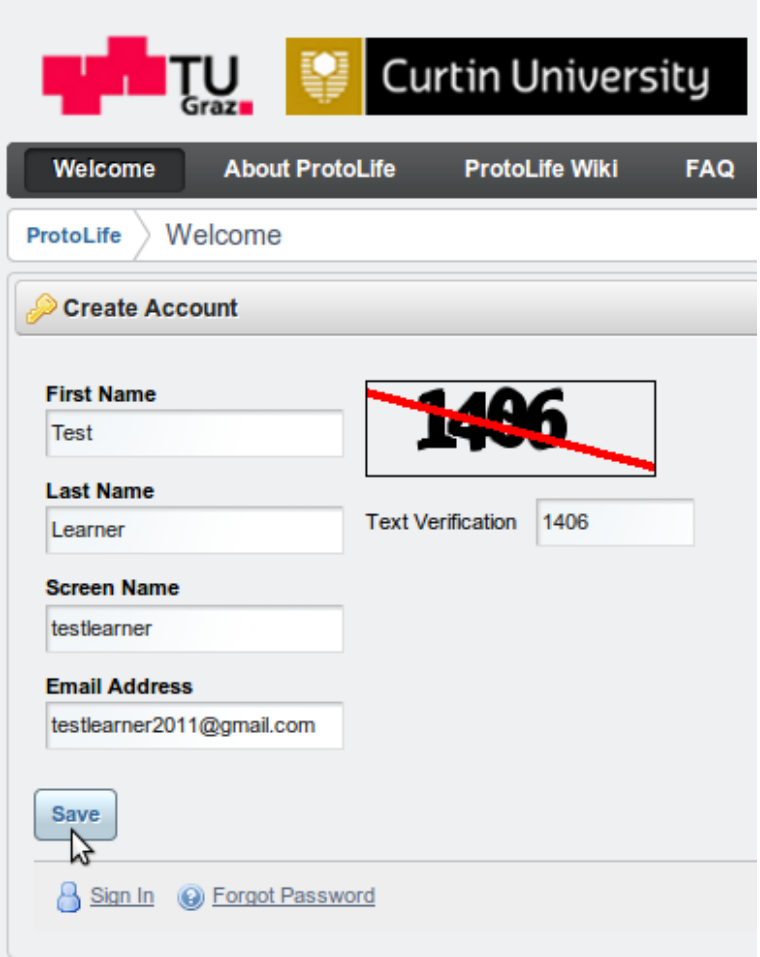


Figure 7.3: Create an user account

The created password is sent to the provided e-mail address of the user and with this password the user can log in to the portal. The password can be changed after the login process is fulfilled. After the first login the user needs to agree with the terms of use of the prototype, which include general information and restrictions for the use of the prototype. For the password reminder the user has to choose a reminder query, where the user can select from pre-defined questions or write an own question. In case the user forgets the password, the correct answer for the password reminder is necessary.

Users' Private Pages

After the login, every user of the prototype is per default redirected to the users' private pages, as shown in figure 7.4. This behaviour is realised with the *Login Landing Page Hook 1.0* downloadable at the Liferay Community Web page[1]. By following the 'Go to' in the right corner, the personal pages and all available community or classroom pages can be reached. Next to the 'Go to' in the dockbar, the 'profile picture', the 'name' and a 'Sign Out' are visible. Only with the administrator role, the Teacher_Admin role and the Community_Manager role the name is presented as a link to enter the control panel. From there all administrative tasks for the whole portal or any community can be made.

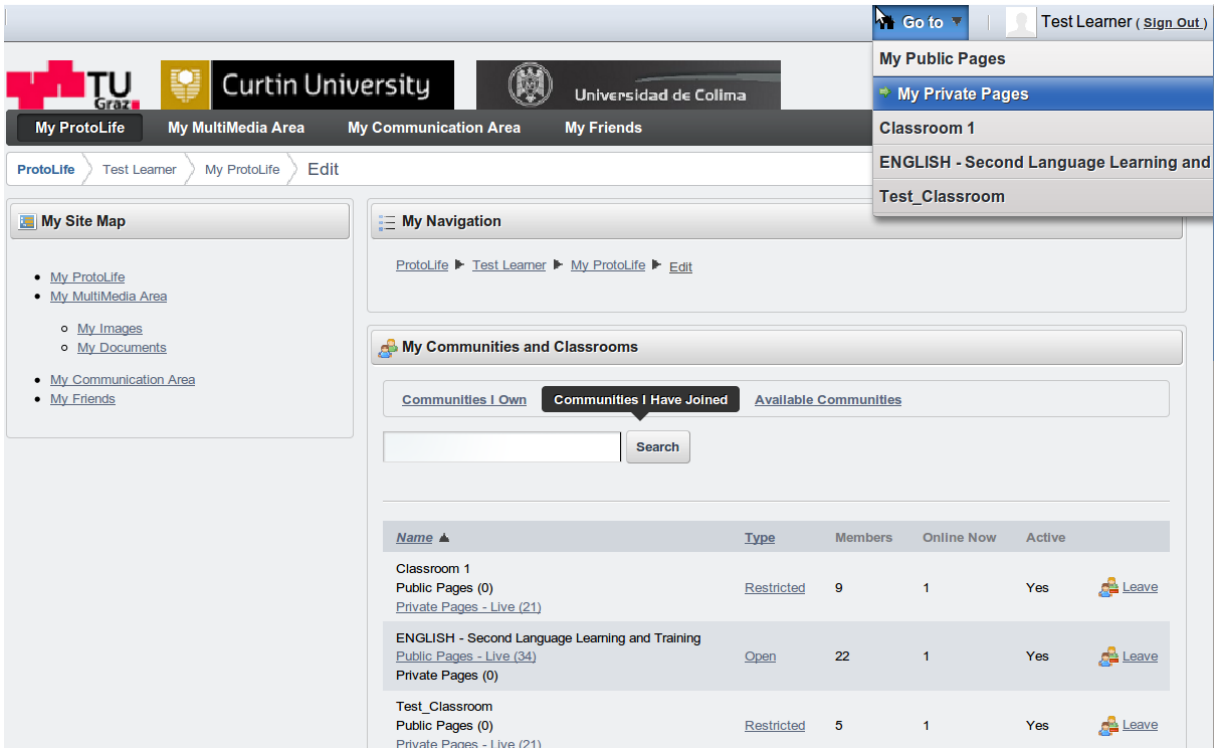


Figure 7.4: Users' private pages

The user can edit account information and can view existing communities within the portal. The user has the possibility to apply for classroom and community memberships per mouse-click. Hidden classrooms or communities are not visible for an user, who is not a member of this hidden classroom or community. An user can request a membership for a classroom or community by choosing 'Available Communities'. Is a community or classroom open, the user can become a member by clicking on 'Join'. If a community or classroom is restricted, the user needs to click on 'Request Membership'. After that, a request is sent to the community or classroom owner, which is the administrator, per e-mail. The administrator can approve or deny the membership request in the control

[1] `http://www.liferay.com/downloads/liferay-portal/community-plugins/-/software_catalog/products/6837361?_98`

panel. The administrator can also assign members to a community or classroom without a request.

Further the user can upload images and documents, create an mail account and manage friends within the portal, but any modification of the personal pages is per default permitted. The test learner, who has per default just the role User within the learning environment, has no access to the control panel . The control panel can usually be accessed via the link behind the user name on the right upper corner. For the role User this access is restricted and was realised via a hook, described in the previous chapter.

Embedding the 'my account' portlet on the users private page, the user can access the account information. Under 'User Information' the user is able to change the screen name, e-mail address, first name, last name and profile picture and can see the users' User ID within the portal. The user can set a new password and change the reminder question. The communities, to which the user belongs, and the certain roles he has, are also viewable. Under 'Identification' the user can announce address, web sites and social networks. Under 'Miscellaneous' the user can modify display settings, e.g. language, time zone and a personal greeting.

Users' Public Pages

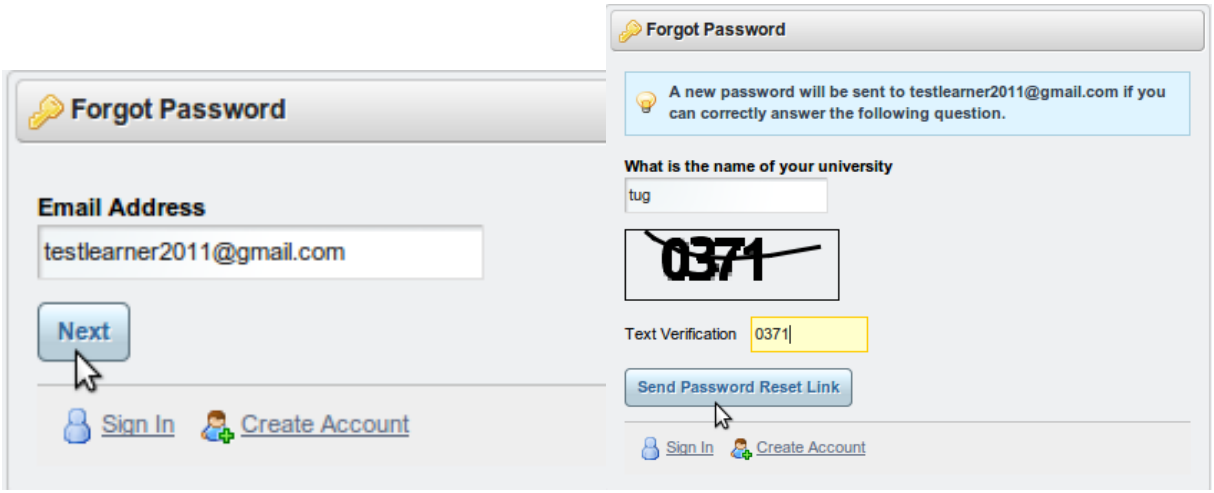
The users' public pages, as partly shown in figure 7.5, are visible for everyone in the Web, even for those without an account for the prototype.

Figure 7.5: Users' public pages

The public pages consist of 'My Profile', 'My Public Wiki' and 'My Publishing Area'. 'My Profile' shows the users' profile picture, a job title chosen by the user, the users' friends within the portal, a wall where the user and friends can leave posts and further friends can leave page comments and give page ratings. Under 'My Wiki' a user has a personal wiki, where the user can write about everything and anything. In 'My Publishing Area' the user can publish documents, images and web content which the user wants to be accessible for anyone.

User Password Reminder

Figure 7.6a shows the case, if an existing user forgets the password to log into the portal. The user can ask for a new password by clicking on the 'Forgot Password' button.



(a) ProtoLife user forgot password

(b) ProtoLife user password reset link

Figure 7.6: Reset forgotten account password

After the user provides the correct e-mail address with which the account has been set up, the user has to answer a password reminder question and has to fill in the text verification correctly, as illustrated in figure 7.6b. After that, a reset link is send to users e-mail address. By following the received link, the user is able to set a new password.

ProtoLife Communities

Every user is per default assigned to the open community 'ENGLISH - Second Language Learning and Training'. When an user is navigating to the history of the portal page 'Info - History of English', the user can use the installed double-click dictionary search. An user can look up a word or phrase by double-clicks on the single word or highlighted phrase, as illustrated in figure 7.7.

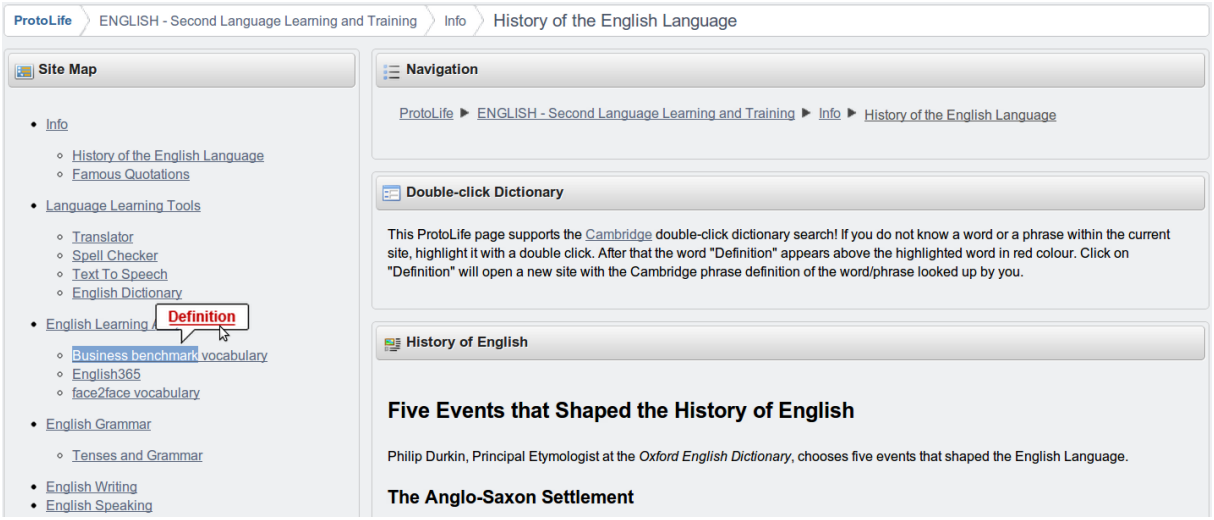


Figure 7.7: ENGLISH community

Further this community offers various English learning and training functions. It offers language learning widgets, e.g. translator, spell-checker, text-to-speech, English dictionary, further English learning aids, grammar writing and speaking. Further many useful links and according to the conceptual idea behind game-based learning, it offers some English games depending on the learners' capacity.

Beneath the 'ENGLISH - Second Language Learning and Training' community, the prototype consists of several learning communities which are set up by the administrator or another user with the role 'Teacher_Admin' or 'Community_Manager. Each learning community is comparable to a classroom in a school. Within such a classroom community there can exist one or more teachers, which have the portal role 'User' and the Community role Classroom_Teacher or Teacher_Admin and several students, which just have the portal role 'User'. A classroom within the learning environment is a restricted community and needs to be created by one of the previous mentioned roles using the site template 'Classroom_PRIVATE', as described in the previous chapter.

The site template, copied to every classroom community, consists of: 'Our Class', where the classroom members are presented; 'Classroom Wiki', for collaborative writing; 'Classroom MulitMedia', where students can view and download images, documents and videos; 'Classroom Collaboration', where the teacher can configure a TitanPad[2] for working together within one document simultaneously with all students or working in groups using several TitanPads; 'Classroom Forum', where every class member can add categories and post new threads; 'Classroom Calendar and Polls', where the teacher can add events to the calendar and can create and publish Doodle[3] polls and 'Learning Tools', where a translator, spell-checker, text-to-speech and dictionary are offered to the classroom members. Figure 7.8 gives an overview of the look of a classroom within the prototype. All listed functionalities can be accessed by any classroom member, but just a member with the

[2] http://titanpad.com/
[3] http://doodle.com/

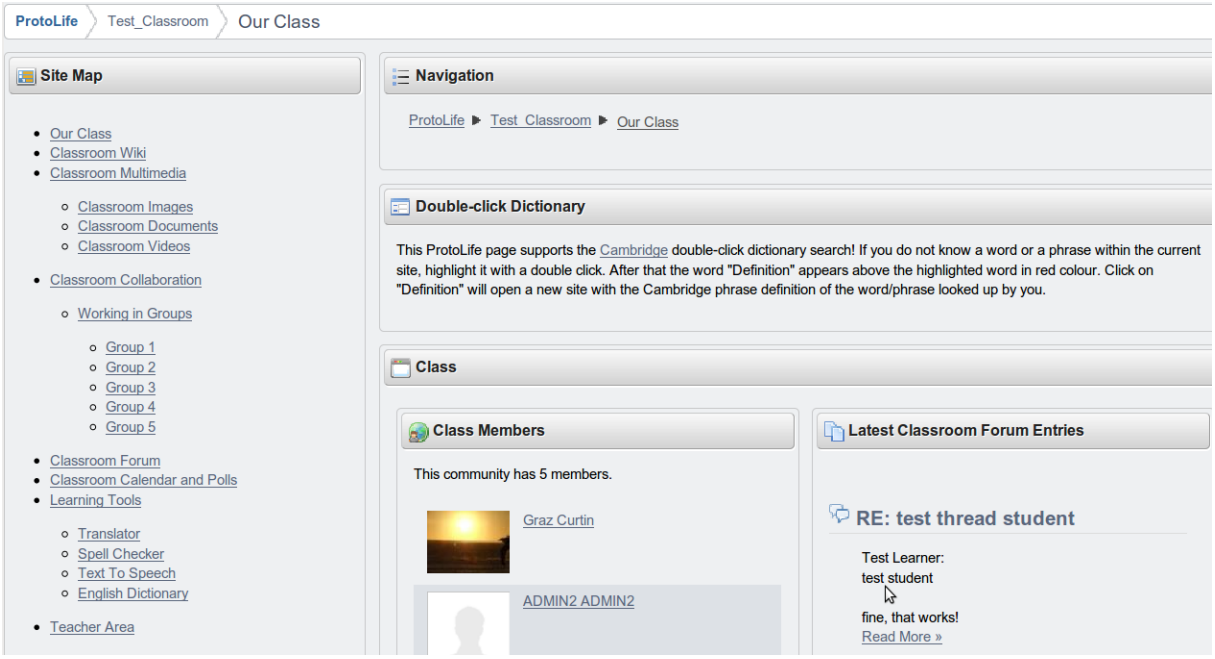


Figure 7.8: Classroom overview

community role Classroom_Teacher has the permission to access 'Teacher Area', where a teacher can organise the learning materials and student documents, send mails using a mailing list and monitor the students classroom. Further if a member is assigned with the Classroom_Teacher, the Teacher_Admin or the Community_Manager role, some portlets like e.g. the iFrame portlet for embedding the TitanPad or for publishing Doodle polls, can be configured by this member.

A classroom has only private pages, this means that a non-member of the classroom is not able to view any content of the classrooms Web pages. Assigning members and certain community roles to specific members can also be handled by the administrator using the control panel. As already mentioned, an user can also ask for membership using the 'community' portlet embedded in the users' personal pages.

7.2 Administrator

The administrator role has all rights within the prototype environment and has access to the portals' control panel, which is used for most administrative tasks, like administer users, create portal structure or implement security. As illustrated in figure 7.9, the prototypes' administrator account offers a monitoring area, where all users and user groups of the portal are listed and the activities of the portal members can be reviewed.

Using the control panel, an administrator has the ability to make changes to the administrators account, add, modify and delete users, communities, user groups, roles, password policies, site templates and so on. The administrator can set the global server settings,

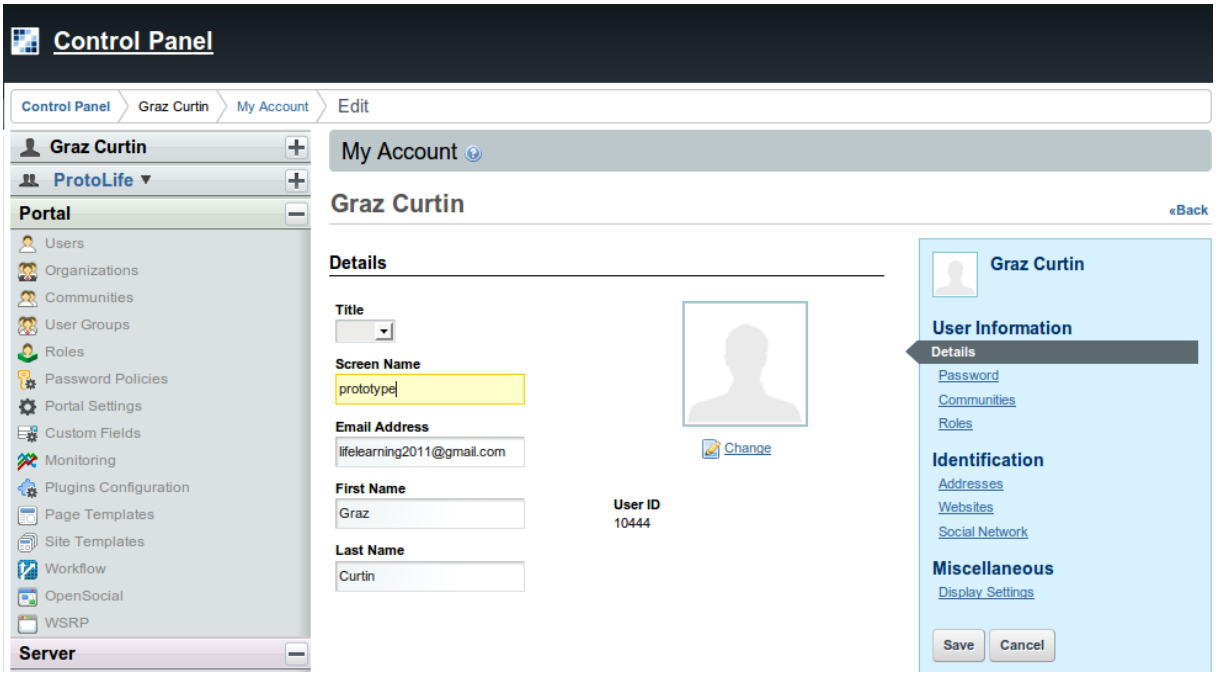


Figure 7.9: Administrator account in control panel

define notifications, set authentication policies and a lot more. The role of an user can only be modified by an administrator through the control panel. If the control panel isn't used correctly, it may cause serious damage to the portal. Further in the 'MultiMedia Area' the administrator can publish content to the start page of the prototype.

To avoid the risk of damage, the following listed design decisions were made: an user shouldn't be able to manage the personal pages; an user shouldn't be able to add more pages to set of personal pages or any other place within the portal; the access to the control panel is denied for every user of the portal who just have the portal role 'User'. This behaviour is realised with a hook that overrides core code and thereafter some default portal setting as described in chapter 6.

7.3 Teacher

The main difference between a student or learner and a teacher is, that the teacher has more administrative rights within the portal. But there are two different roles for teachers as well, the 'Classroom_Teacher' with some more rights than a normal 'User' and the 'Teacher_Admin' with administrative, which includes creating classroom and more. Especially in development countries, in third world countries or for not technically affine users, it can be a problem having too many administrative rights. To ban a risk of damage within the portal, the role 'Classroom_Teacher' was created.

Having the role 'Classroom_Teacher' within the prototype, a teacher hasn't many rights to change or edit pages or content. The 'Classroom_Teacher' can access the control panel,

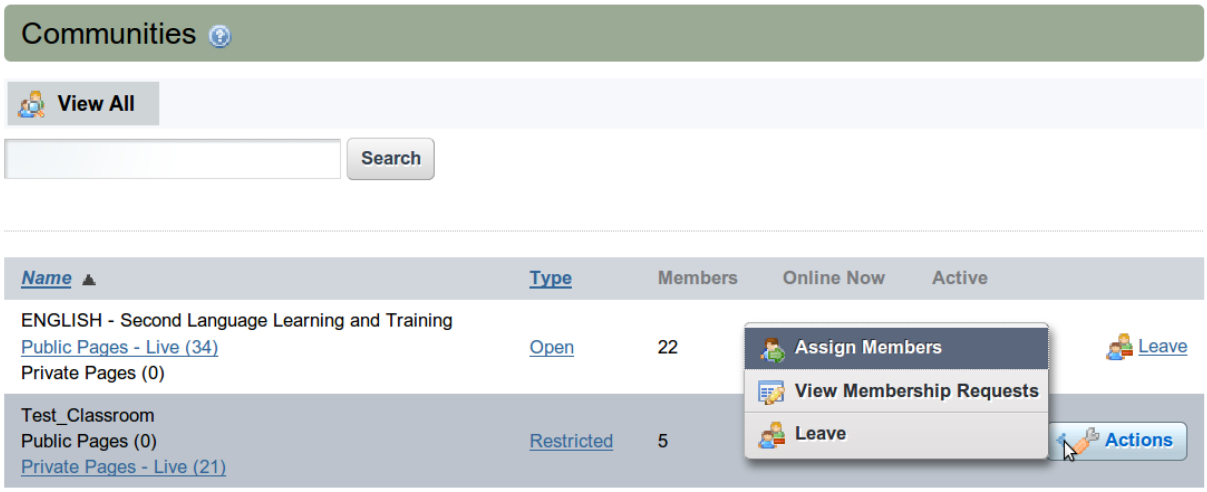


Figure 7.10: 'Classroom_Teacher' edit community in control panel

view the communities, view and answer membership requests for his classrooms and can assign members to his classrooms, as shown in figure 7.10. Further the 'Classroom_Teacher' is allowed to view the 'Teacher Area' within the classroom pages and modify and manage the content of those pages.

Giving the same user the second teacher role, the 'Teacher_Admin', the certain user having this role has definitely more rights within the portal. Such an user is able to create new communities using site templates, edit those communities and assign members to the communities.

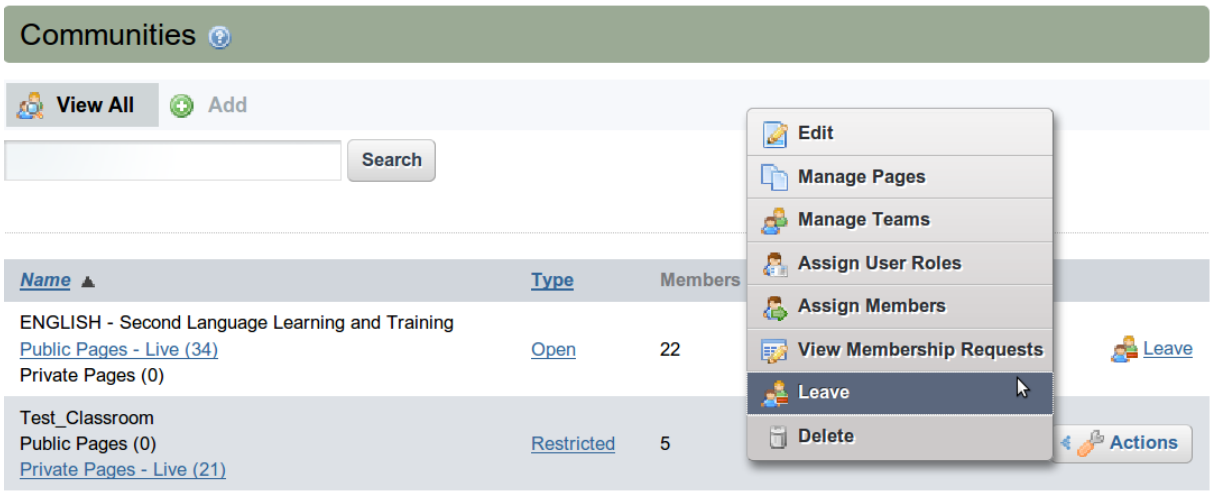


Figure 7.11: 'Teacher_Admin' editing community in control panel

Even deleting created communities by the teacher, isn't a problem at all. That all happens accessing the control panel, as illustrated in figure 7.11.

7.4 Learner

As already mentioned, any user of the environment is per default a learner or normal user within the prototype environment. Just the administrator is allowed to assign users with roles. If an user is a learner who just wants to learn self-paced or a student, who is a member of a classroom, there is no need to assign a further role to that user. A normal user within the environment has no access to the control panel, as presented in figure 7.12. Otherwise the name in the upper right corner would appear as a link to access the control panel.

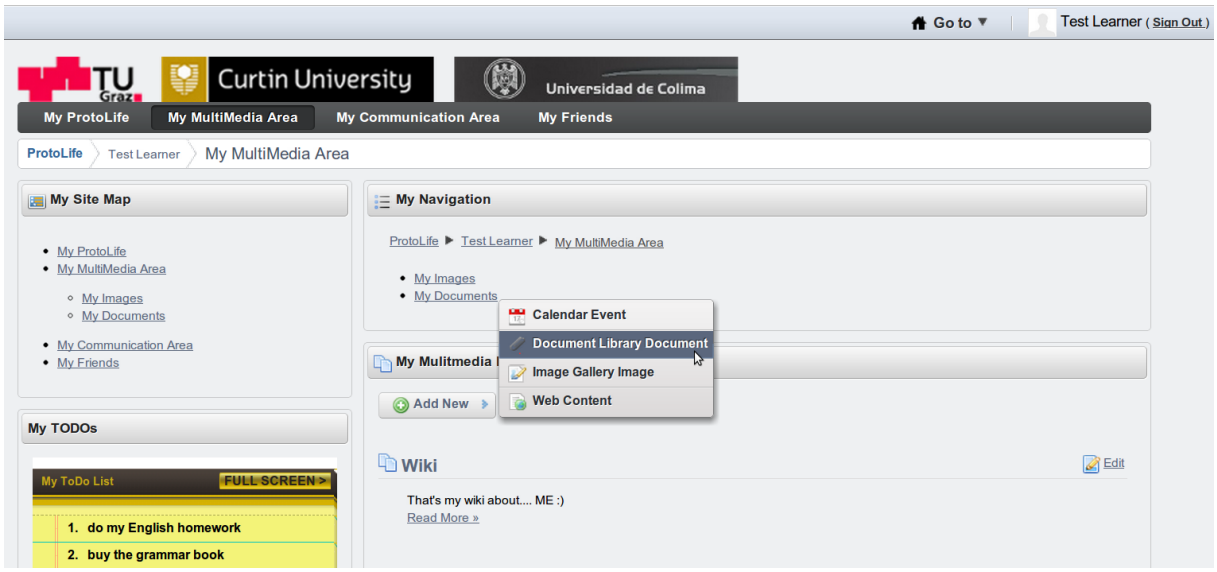


Figure 7.12: Learners private pages

A lot of functionality is provided to the user. Within the private pages, an user can edit the own account, apply for community memberships or upload documents and images and therefore use the prototype as an online backup and share those documents with friends. Further the user can manage appointments using the provided calendar and use the prototype as e-mail client as well. Also friends can be searched and friendship requests can be answered using the private pages. If the user should be able to create and maintain own communities, e.g. for language lovers, the administrator needs to assign the learner with a further role using the control panel: the 'Community_Manager' role. This gives the learner similar rights like the 'Teacher_Admin' role and the learner is now allowed to access the control panel and create and manage communities within the environment.

7.5 Selected Tools of the Prototype

Some selected tools that are implemented within the prototype environment are described more detailed in the following subsections.

7.5.1 Language translation

The existing online translator 'Reference Box[4]' is integrated into the prototype using the iFrame portlet. This translator offers four possibilities how the inserted text should can be handled:

- Translate the inserted text from one language into another, as illustrated in figure 7.13.
- Count the words form the text, that has been inserted.
- Change the case of the inserted text into upper (EXAMPLE), lower (example) or title case (Example).
- Reorder the inserted text according to the alphabet or inverted.

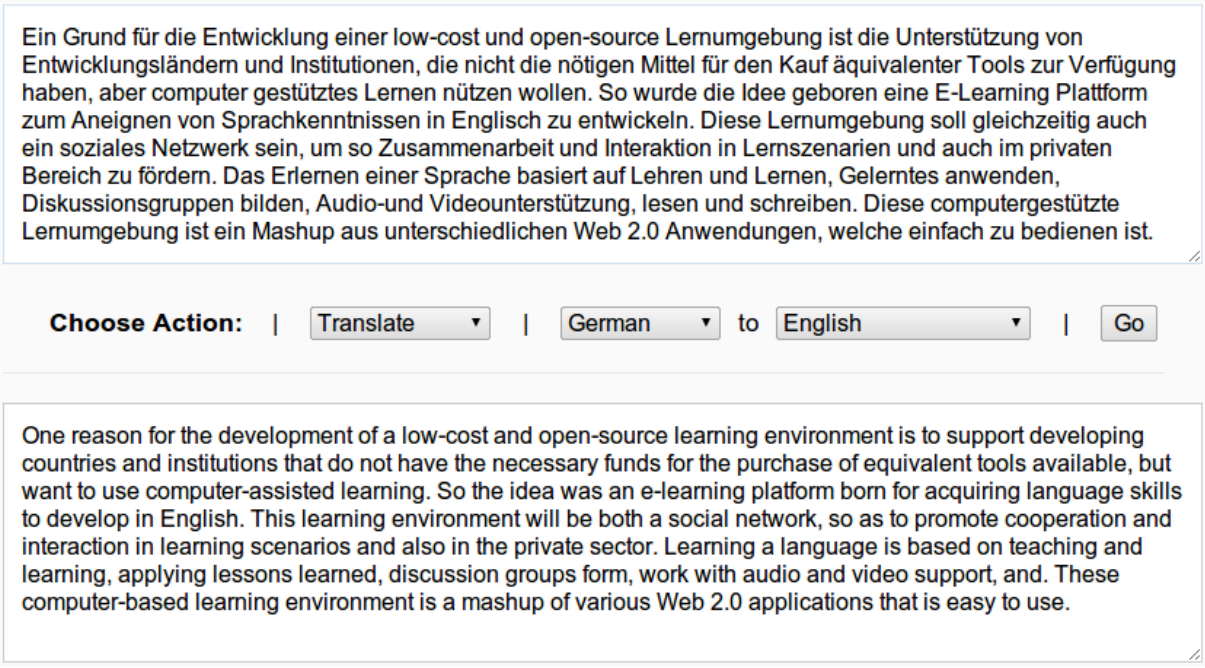


Figure 7.13: Reference Box: Translator

The 'Reference Box: Translator' is either available within the 'ENGLISH - Second Language Learning and Training' community for every user of the prototype and further placed in the private pages of every community or classroom.

[4] `http://wordmonkey.info/`

7.5.2 Spell checker

Similar to the previous described translator, the spell checker 'jspell[5]' is integrated using the iFrame portlet as well. Therefore the text, which should be checked, needs to be placed into the text box and the spelling will be checked after clicking on the 'Spell Check' button. Figure 7.14 shows the functionality of the spell checker within the prototype.

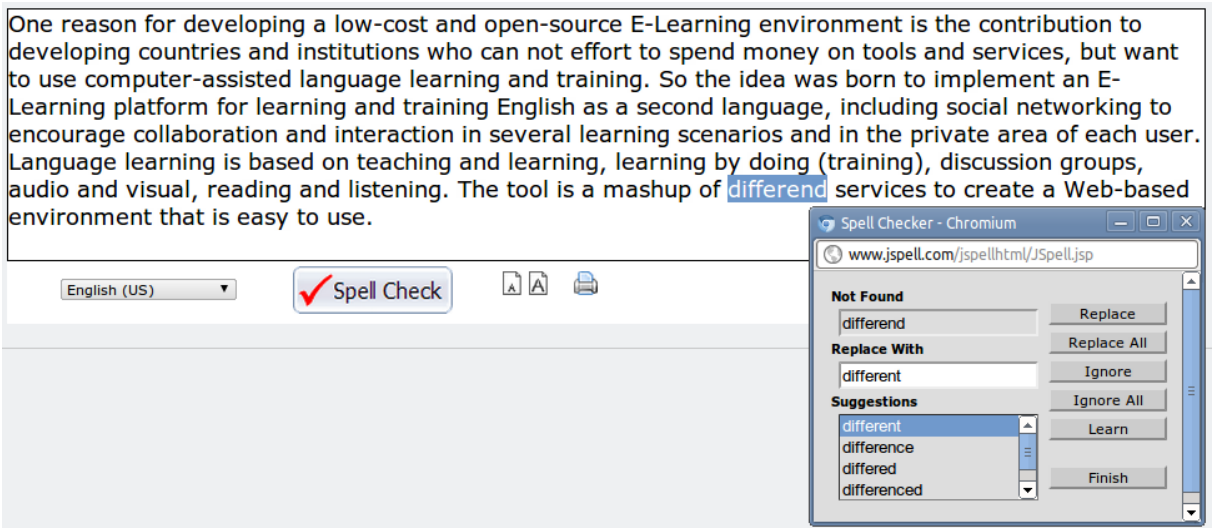


Figure 7.14: jspell spell checker

Like the translator, the spell checker is also placed on every private page of each community or classroom and is available in the 'ENGLISH - Second Language Learning and Training' community.

7.5.3 Dictionary

The 'English dictionary[6]', as illustrated in figure 7.15, has been integrated into the prototype using OpenSocial.

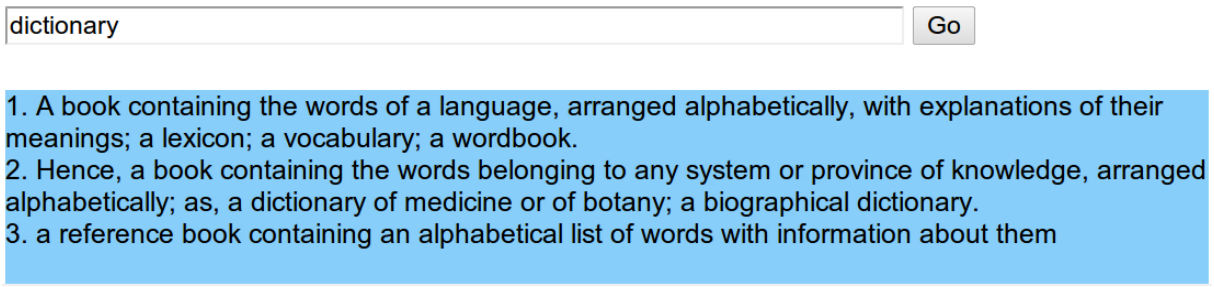


Figure 7.15: English dictionary

[5] http://www.jspell.com/
[6] http://rams-gadgets.googlecode.com/svn/trunk/youlicit/dictsamepage

Words can be looked up by placing them in the text box and clicking on the 'Go' button. This functionality is placed to every community or classroom and the 'ENGLISH - Second Language Learning and Training' community.

7.5.4 Text-to-speech

The 'text-to-speech converter[7]', as shown in figure 7.16, is compound with the prototype using the iFrame portlet. After placing the text into the text box and clicking on 'Convert Text To Speech', a MP3 file is generated which needs to be downloaded on the hard disk.

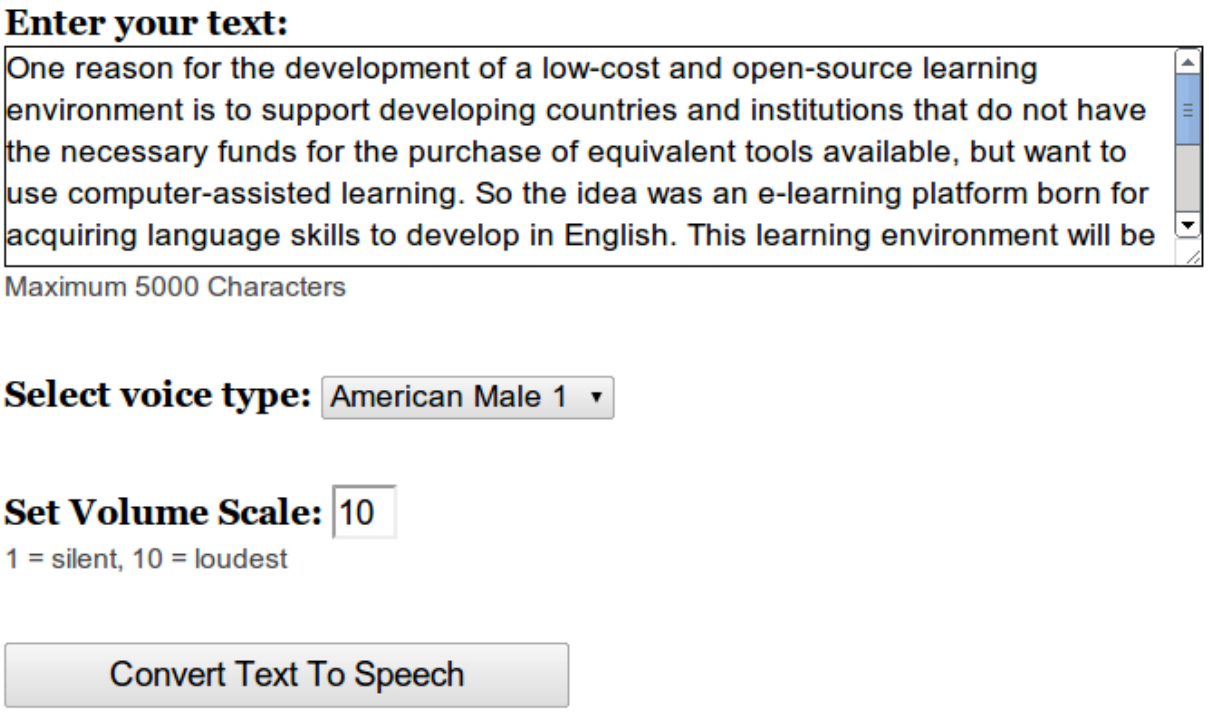


Figure 7.16: Text-to-speech converter

This text-to-speech converter is placed in every community or classroom and in the 'ENGLISH - Second Language Learning and Training' community as well.

[7] `http://www.text2speech.org/`

7.5.5 Cambridge English language teaching

Beneath the already mentioned learning tools, the prototype provides the 'Cambridge English Language Teaching' aids. Those conclude the 'English365[8]' course, as shown in figure 7.17, the 'Business Benchmark[9]' trainer and the 'face2face elementary Vocabulary Trainer[10]'.

Figure 7.17: Cambridge English365 trainer

These learning aids are available on the 'ENGLISH - Second Language Learning and Training' community page.

7.5.6 English games

The 'ENGLISH - Second Language Learning and Training' community page further provides a lot of English games for language learning clustered in the levels beginners, advancers and profis. Figure 7.18 illustrates, how a selected learning game for beginners looks like.

The following games were integrated into the prototype:

- Wordcentral games[11] - BIGbot, Robo Bee and Alpha Bot
- Ambleside primary[12] - Look Cover Write and Check
- Zaner-Bloser[13] - Spelling Connections
- BBC KS2 Bitesize[14] - Argument, Deduction, Dictionary and Questionaut

[8] http://cdextras.cambridge.org/VocabTrainer/english365/
[9] http://cdextras.cambridge.org/VocabTrainer/bbav/
[10] http://cdextras.cambridge.org/VocabTrainer/face2face/start.swf
[11] http://www.wordcentral.com/games
[12] http://www.amblesideprimary.com/ambleweb/lookcover/lookcover.html
[13] http://www.zaner-bloser.com/educator/products/spelling/
[14] http://www.bbc.co.uk/schools/ks2bitesize/english/

Figure 7.18: English game: Spelling connections

7.5.7 Double-click dictionary search

When the 'double-click dictionary search' portlet, as illustrated in figure 7.19 is placed on a page within the portal, all content within the page can be chosen to look up the definition of either a word by double-clicking it or a phrase by highlighting the designated phrase and then click on the red 'Definition' link that pops up.

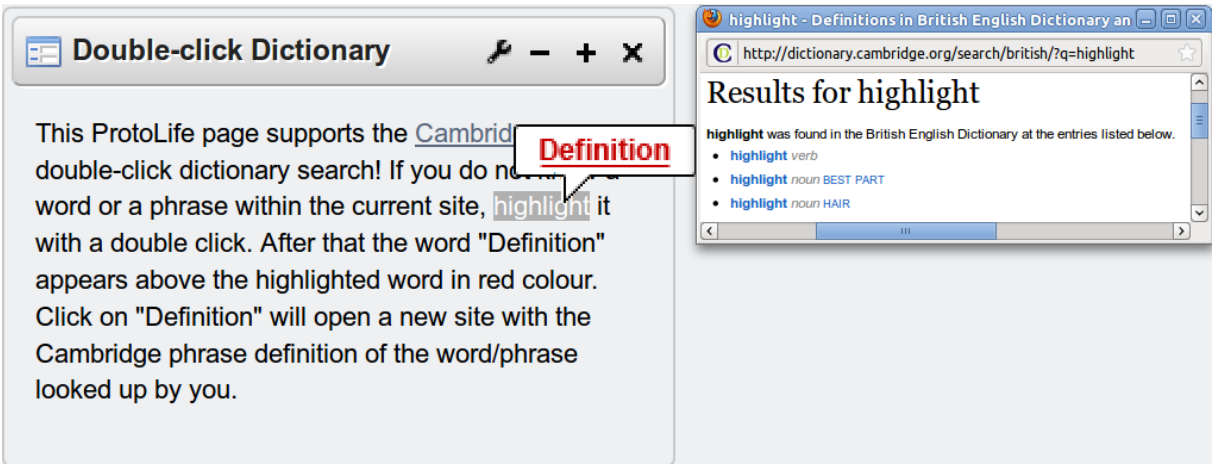


Figure 7.19: Cambridges' Double-click dictionary search

The 'double-click dictionary search' is placed on several pages within the prototype.

To give an example the double-click dictionary search is placed in the forum within every community or classroom, as presented in figure 7.20. Definitions of words and phrases posted in threads of the forum can be looked up.

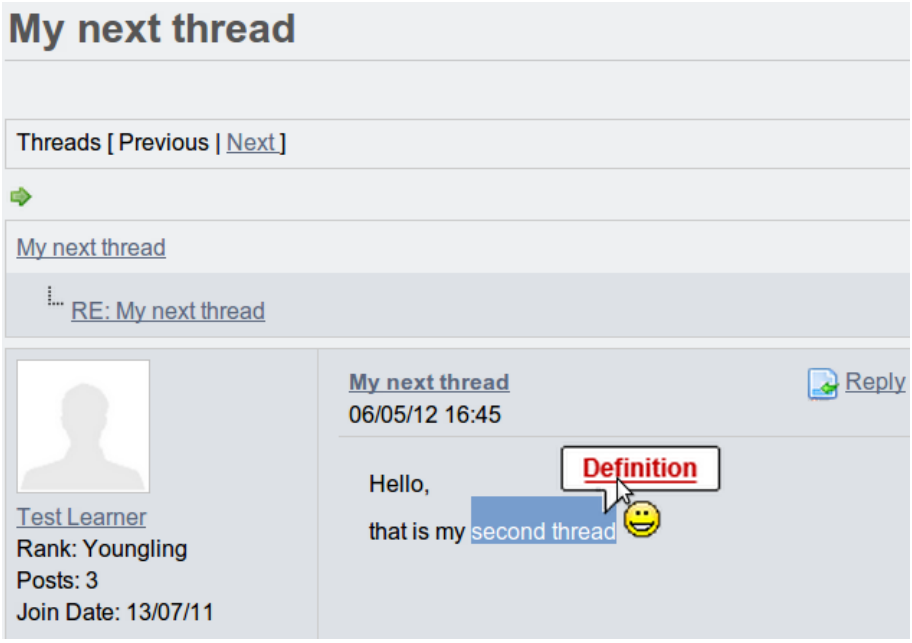


Figure 7.20: Using double-click dictionary search in the forum

7.5.8 Search and invite friends

As the social aspect within online learning environments is very important, the prototype offers the possibility to search and become friends within the portal. One way is to access the public site of the desired friend. If the users aren't already friends, the user who visits another users' public page can click the 'Add as Friend' button and a friendship request is sent to the desired friend.

The second way to become friends is by using the 'search and invite friends' portlet, presented in figure 7.21, which is placed in the tab 'My Friends' on the private pages of every user.

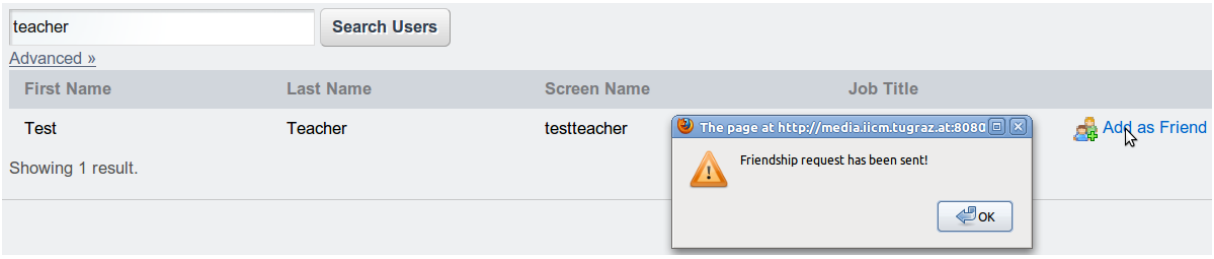


Figure 7.21: Search and invite friends

Friends can be searched by the first name, the last name or the screen name. All results of the search are presented to the user in a list. By clicking on the 'Add as Friend' button, the desired friends receives a friendship request.

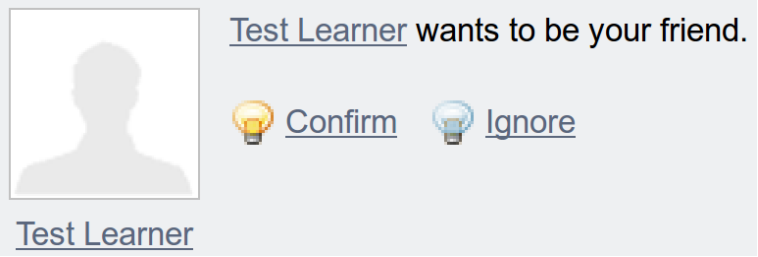


Figure 7.22: Confirm friendship request

As shown in figure 7.22, an user can confirm or ignore a friendship request within the prototype. After the confirmation of the friendship request, the two users are friends within the portal, which has an impact on the later described 'chat' portlet.

7.5.9 Collaborative writing with TitanPad

The TitanPad is an application for collaborative real-time writing and is very easy to integrate to the portal using the 'iFrame' portlet, as already mentioned in chapter 6.

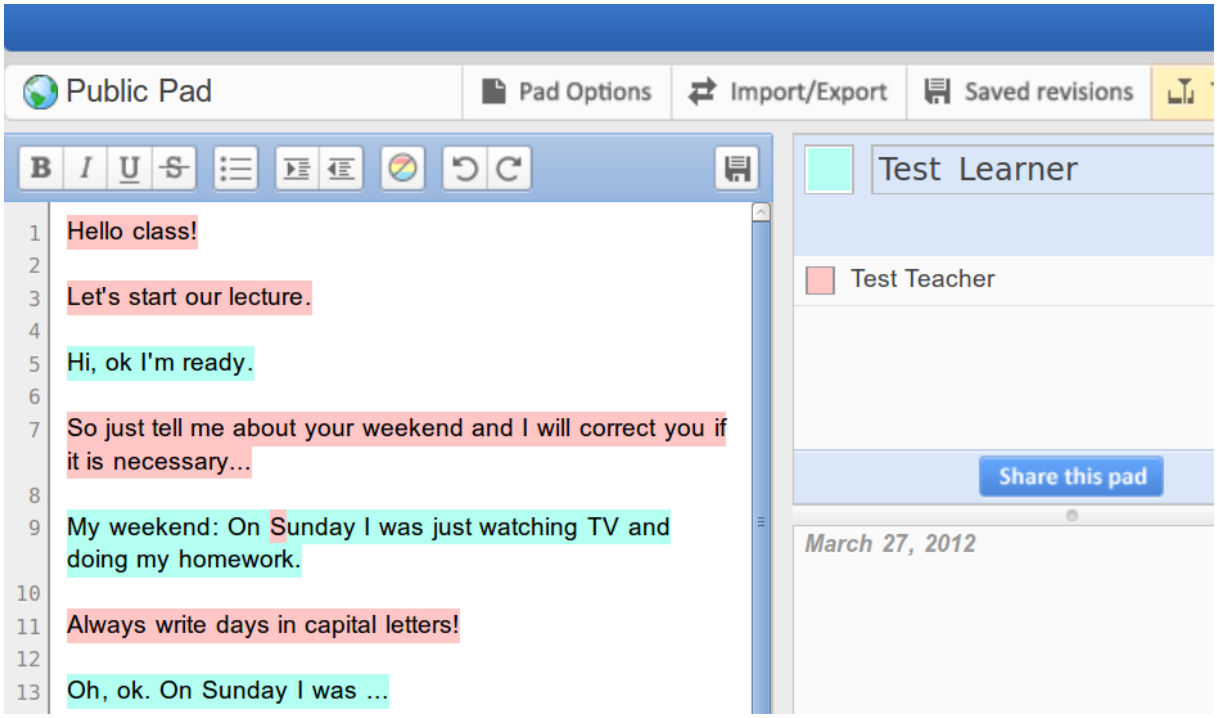


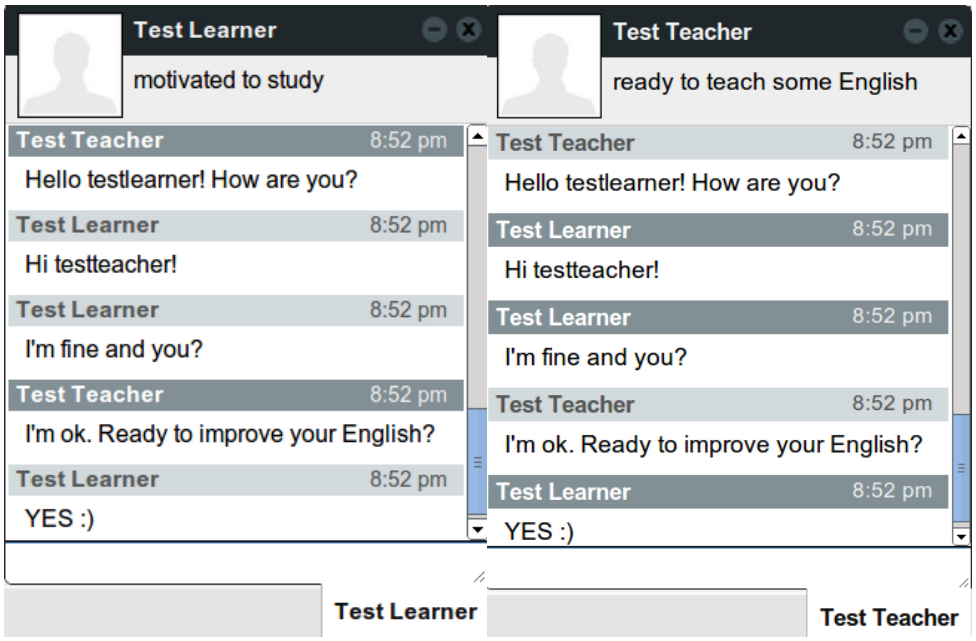
Figure 7.23: TitanPad for collaboration

In a second tab a new TitanPad needs to be created, which is a new instance of a TitanPad. The URL needs to be copied and can then be placed in the 'iFrame' portlet on the e.g.

collaboration page of a classroom by clicking the wrench in the upper right corner, selecting 'Configuration' and then placing the TitanPad URL into the 'Source URL' field. After that the URL is automatically loaded into the 'iFrame' portlet and the newly created TitanPad is ready for use, as shown in figure 7.23. Every user, who is member of the community can select a highlighting colour and can start writing on the TitanPad.

7.5.10 Chat Tool

The 'chat' portlet, as illustrated in figure 7.24, is implemented for synchronous communication within the prototype and this service is just available for befriended users within the portal.



(a) Chat teacher-view **(b)** Chat learner-view

Figure 7.24: Chat portlet various

Further it is just possible to chat with a friend who is online, means logged into the portal. An user can add a personal status to the chat function, which is then displayed in the lower left corner of the prototype environment and in the chat window itself. The chat is embedded on the right corner within the prototype pages.

7.6 Conclusion

From the users point of view, the great flexibility and various provided learning tools are a huge benefit of the prototype. As the prototype contains multiple pages providing a lot

of content, a 'site map' and a 'navigation' portlet makes the navigation for the user easier and avoids, that a user get lost within the portal.

Boruta, Chang, Gütl, and Edwards (2012) stated, that the layout of the prototype has a look and feel of social media platforms. This issue adds intuitiveness to the application, as there is a similarity of the prototype layout to other existing social media platforms. To register for the platform, to provide personal information, to upload pictures and to share documents is not only for today's students a very common situation. The social media aspect provided from the prototype additionally attracts the users attention. The welcome page provides a Wiki that includes information about the basic functionalities of the prototype and FAQs are available as well, for covering the main questions regarding the portal. Through the intuitive layout of the Web site, an user should be able to use the prototype after a short self-study period. As there is a bunch of functionalities and tools, there is the risk that a not technically affine teacher or user may feel overwhelmed. Therefore a manual is available with information regarding the roles within the system and the according privileges that comes along with a role.

The variety of tools and functionalities within the prototype is on the one hand amazing, but on the other hand users have to get along with a number of partly unfamiliar tools (see also Boruta et al. (2012)). That can be difficult and therefore it is absolutely necessary to have the FAQs, a Wiki with general information and a contact, where users may ask if any problems occur.

The administration of the prototype through the control panel is a comfortable solution, as the user interface is well managed and after a short period of time spend it seems simple to use as well. Creating and managing communities and classrooms can be done by a 'Teacher_Admin', a 'Community_Manager' or by an administrator within the prototype. This procedure requires more effort, but once the certain users knows how, creating communities is a very simple and fast process, as site templates have been implemented. Teachers can assign students to learning groups and assign special tasks to those groups. There is space for communication and collaboration provided, which is the present and future key to successful learning. As learning should make fun as well, there are also educational games available on the platform.

Further the single-sign-on solution is very comfortable for users. There is no need to leave the prototype for any reason, because all functionalities, content and tools are integrated within one environment. Not just the prototype itself, also some researched Web 2.0 tools are worth to mention. The TitanPad for synchronous collaborative writing is more than useful and the double-click dictionary search is an awesome feature for almost every Web page. But anyway for not technically affine users, some kind of training or how-to videos should to be provided. Otherwise those users could get frustrated and even if the prototype is free, they might stop using it.

Chapter 8

Summary and Outlook

In course of this master's thesis, a social platform for English language learning and training has been implemented. The set target of this work was to identify suitable Web 2.0 technologies and tools and combine them within an E-Learning environment for the application domain English. One main goal was to implement a prototype, where the areas technology, pedagogy and social behaviour are covered in a satisfying way.

The results of a detailed literature survey revealed the key characteristics of successful E-Learning: personalisation, synchronous and asynchronous communication, collaboration and interaction, instructor-led and self-study learning and sharing of resources. Previous research in the language learning area are showing, that Web 2.0 technologies are effective tools for education in foreign language learning. They enable key characteristics like collaboration, communication and interaction.

The main idea for developing a low-cost and open-source E-Learning system was the contribution to the community, developing countries and institutions, who can not effort to spend money on tools and services, but want to use computer-assisted language learning and training.

This work illustrates the capabilities of Web 2.0 combined with social networking aspects. As learning occurs through interaction, this approach pursues the idea to make learning more attractive through social interaction, as reported in Boruta et al. (2012). As the prototype is a single-sign-on solution, learning and social interaction takes place within one environment. The user does not need to change from the learning system to another social networking platform to communicate with friends and other students. This aspect can reduce disadvantages of E-Learning, like e.g. the feeling of isolation. As the focus is not only directed solely on learning and training, the prototype can address a wide group of potential users.

Liferay is a valuable platform and can be reported as a good basis for the purpose of this master's thesis. The extensive literature research, the evaluation and the final implementation of the prototype required a lot of time, hence some parts of this master's thesis were developed or researched in an abbreviated form.

The following points mention some further possible improvements of the prototype:

- Upgrade to Liferay 6.1.
- Replace the current text-to-speech function by an equivalent but more user-friendly alternative, e.g. jTalk (jQuery text-to-speech plugin, support text-to-speech with text highlighting).
- Integrate e.g. the 'After the Deadline' spell, grammar, and style checker.
- Unlock the blog function for the users of the prototype. As it is already provided by Liferay, this is easy and fast realisable.
- Adjust the layout of the prototype and remove frames within portal pages.
- Implement predefined learning environments suitable for different learning settings to help not technically affine and not Web 2.0 experienced teachers or users.
- Enable and disable selected learning tools within learning activities.
- Provide further assessment and feedback tools.

During this master's thesis, two papers were published together with Dr. Christian Gütl[1], Dr. Vanessa Chang[2] and Dr. Arthur Edwards[3]:

- Interactive Collaborative Learning (ICL) Conference: Foreign-language learning environment using Web 2.0 technologies
- International Journal of Engineering & Technology (iJET): Flexible and Affordable Foreign Language Learning Environment based on Web 2.0 Technologies

The prototype provides a broad spectrum of usable services and tools. The final result of this master's thesis is a first proof of integrating an E-Learning platform for the specific application domain English as a second language with social aspects, to encourage collaboration and further interaction, within one learning environment.

[1]Graz University of Technology
[2]Curtin University Perth
[3]Universidad de Colima

Appendix A

Liferay Documentation

This chapter first gives an overview about available sources of information regarding the Liferay portal software.

Liferay provides many documents on their Web page. Beneath the Liferay Wiki and forum, documentation regarding the first steps, administration and development are available. Not all sections are entirely complete, but those documentations are a pretty good way to get started with Liferay.

- Liferay Portal 6.0 - Getting Started[1]
- Liferay Portal 6.0 - Administration[2]
- Liferay Portal 6.0 - Development Guide[3]

In addition to the above mentioned documents, the 'Community'[4] is one of the most important source of information. As Liferay is open source, it is used by a lot of people around the world and therefore Liferay provides some space to interact, communicate and to gain and transfer knowledge about Liferay and all its issues and problems. Within this community, tons of lines of code and information are available in the different kind of communication channels categorised into subjects.

- Community Wiki[5]
- Community Forums[6]
- Community Blogs[7]

[1] http://www.liferay.com/documentation/liferay-portal/6.0/getting-started
[2] http://www.liferay.com/documentation/liferay-portal/6.0/administration
[3] http://www.liferay.com/documentation/liferay-portal/6.0/development
[4] http://www.liferay.com/community/welcome/start-here
[5] http://www.liferay.com/community/wiki
[6] http://www.liferay.com/community/forums
[7] http://www.liferay.com/community/blogs

- Community Plugins[8]

All the above provided community sources are very useful and essential for working and development under Liferay. Especially in the Forums lots of information and tips can be found. Community plugins are downloadable plugins which are developed from the community for the community. These plugins are freely available, but the integration into the Liferay system should be taken with caution. As those plugins are developed from the community for the community, there is no official control or review. Many of those provided plugins do not work, some are only compatible with a specific Liferay version and according to this issues, it's not always the easiest way to integrate the community plugins into the portal.

Further Liferay provides a realtime chat, weekly realtime video sessions, worldwide events and roadshows, JIRA issue tracking system and user groups.

[8] `http://www.liferay.com/downloads/liferay-portal/community-plugins`

Appendix B

Prototype Installation, Setup and Execution

This chapter describes teh installation process from downloading and installing of Liferay to the set up and using of the prototype is described.

B.1 Prototype Development Environment

This section describes the working and development environment which was necessary for developing the prototype and the installation of all additional required software packages.

- Ubuntu 10.10, 64bit
- Java Development Kit (JDK), see listing B.1 for installing the package.

```
sudo apt-get install sun-java6-jdk
```

Listing B.1: Install JDK

- Java version 1.5 and up is recommended for working with Liferay. To verify a correct Java version, see listing B.2 after typing 'java -version' in the command line.

```
stefi@laptop:~$ java -version
java version "1.6.0_24"
Java(TM) SE Runtime Environment (build 1.6.0_24-b07)
Java HotSpot(TM) 64-Bit Server VM (build 19.1-b02, mixed mode)
```

Listing B.2: Java version

- MySQL Server version: 5.1.49-1ubuntu8.1 (Ubuntu), see listing B.3 for installing the package.

```
sudo apt-get install mysql-server
```

```
mysqladmin -u root password your-new-password
mysqladmin -h local-machine-name -u root -p password your-new-password
sudo /etc/init.d/mysql restart
```

Listing B.3: Install MySQL

- Apache Ant, see listing B.4 for installing the package.

```
sudo apt-get install ant
```

Listing B.4: Install Ant

- Subversion, see listing B.5 for installing the package.

```
sudo apt-get install subversion
```

Listing B.5: Install subversion

- Liferay Portal Community Edition 6.0.6 bundled with Tomcat 6.0.29[1]
- Eclipse Helios[2]
- Liferay Plug-ins SDK 6.0[3]

Liferay provides an installation guide[4] and a getting started tutorial[5] for the Liferay Integrated Development Environment (IDE). Liferay IDE is an extension for the Eclipse platform that supports development of plug-in projects for the Liferay Portal platform. For creating Liferay plug-in projects, the Liferay Portal and the Liferay Plug-ins SDK[6] needs to be installed and configured in the IDE. Plugins Software Development Kit (SDK) is a command-line-driven development environment for plugins like portlets. It is based on the Apache Ant tool and can be used directly from the command line or can can be integrated with all common IDEs. Building plugins in the Plugins SDK requires Ant 1.7.0 or higher.

B.2 Liferay Installation and Startup

This section describes how to install the development environment.

After downloading the Liferay Portal Community Edition 6.0.6[7] and following the steps in the Liferay Administration Guide 6.0[8], chapter 2. Initial Setup.

[1] http://www.liferay.com/downloads/liferay-portal/available-releases
[2] http://www.eclipse.org/downloads/packages/release/helios/sr2
[3] http://www.liferay.com/downloads/liferay-portal/additional-files
[4] http://www.liferay.com/community/wiki/-/wiki/Main/Liferay+IDE+Installation+Guide
[5] http://www.liferay.com/community/wiki/-/wiki/Main/Liferay+IDE+Getting+Started+Tutorial
[6] http://www.liferay.com/community/wiki/-/wiki/Main/Plugins+SDK
[7] http://www.liferay.com/downloads/liferay-portal/available-releases
[8] http://ebookbrowse.com/gdoc.php?id=97021684&url=1b2a5f893d77df1bfcb3dc6f2ee74281

B.2.1 Liferay Startup

After an successful installation of Liferay bundled with Tomcat, as described in B.2, the Tomcat application server can be started with the command './startup' in the liferay-portal-[version] /tomcat-[tomcat-version] /webapps /bin directory.

To see the Tomcat logs in the console, drop the following prompt of listing B.6 in the command line.

```
tail -f ../logs/catalina.out
OR
less ../logs/catalina.out
```

Listing B.6: Show catalina logs in console

B.2.2 MySQL Database

Further it is necessary to create an empty database *lportal* and an user, as illustrated in listing B.7.

```
mysql -u root -p
create database lportal;
grant all on lportal.* to 'liferay'@'localhost' identified by 'liferay' with grant
    option;
grant all on lportal.* to 'liferay'@'localhost.localdomain' identified by 'liferay'
    with grant option;
```

Listing B.7: Create mySQL-database and user

B.2.3 Modify default settings

After the startup process the browser automatically launches the default Liferay home page at `http://localhost:8080` . Login with the testuser with username:test@liferay.com and password:test. The terms of use need to be accepted and after that it is possible to create an user using the control panel. As the Liferays' default test user is an administrator, it is possible to create another user with the role administrator for the portal, as shown in figure B.1.

To give the new created user administrator rights is possible using the control panel: User → Roles → Select → Administrator. After that logout with the testuser and login with the new created administrator 'Graz Curtin', Email lifelearning2011@gmail.com and password tool2011.

Liferay comes bundled with many plugins. It's common to remove them to speed up the server startup. To do this, in the path liferay-portal-[version] /tomcat-[tomcat-version] /webapps directory all directories except ROOT and tunnel-web need to be deleted. The directories *sevencogs-hook*, *sevencogs-mobile-theme* and *sevencogs-theme* should be remove and then the server needs to get started again.

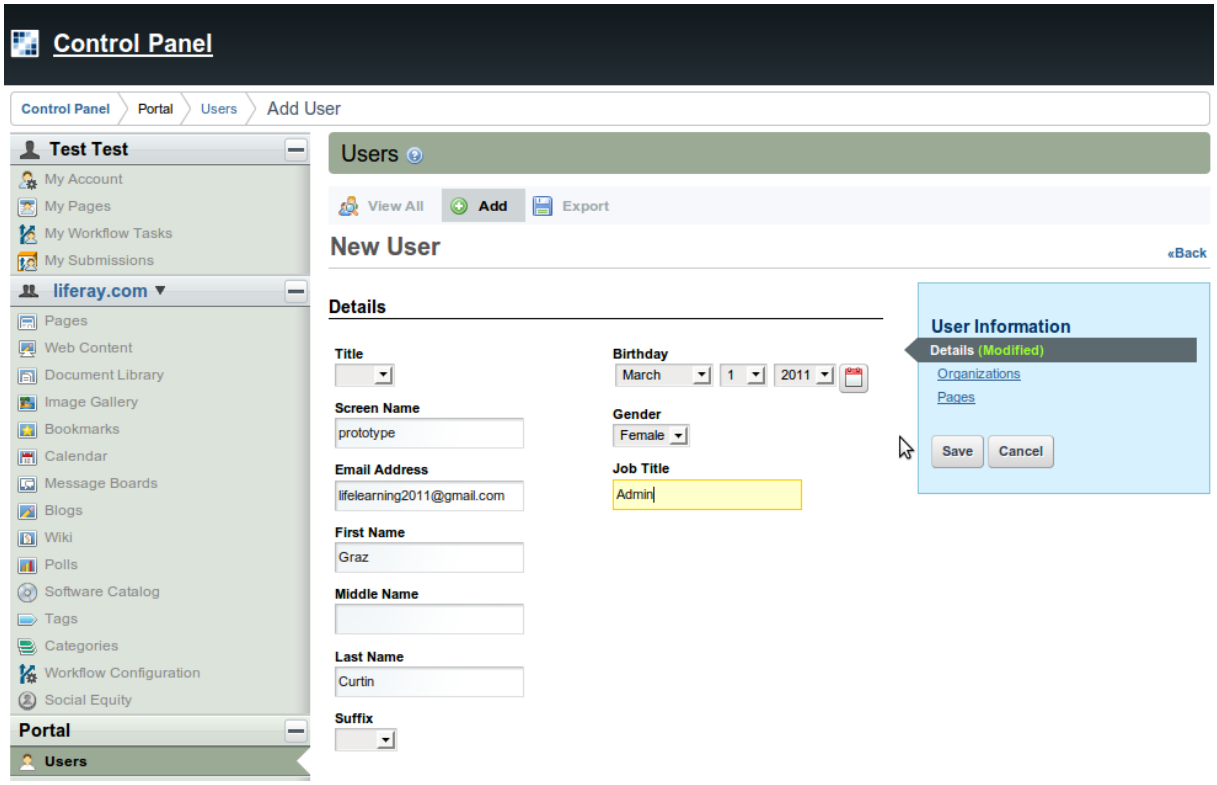


Figure B.1: Create Administrator account

In file build.[username].properties located liferay-portal-[version] /tomcat-[tomcat-version] /webapps place the path of the application server, as shown in listing B.8.

```
app.server.dir=/home/stefi/TU/DA/Liferay/liferay-portal-6.0.6/tomcat-6.0.29
```

Listing B.8: Set path of application server

B.2.4 portal-ext.properties

The portal.properties file is the main configuration file for the Liferay portal. It contains a detailed explanation about the properties. Regarding Liferays principle include an override, customisations of the portals properties are done through the file portal-ext.properties. Listing B.9 shows the beginning of the portal.properties file.

```
##
## Properties Override
##

    #
    # Specify where to get the overridden properties. Updates should not be made
    # on this file but on the overridden version of this file. Furthermore, each
    # portal instance can have its own overriden property file following the
    # convention portal-companyid.properties.
    #
    # For example, one read order may be: portal.properties, then
```

```
# portal-ext.properties, then portal-liferay.com.properties.
#
include-and-override=portal-ext.properties
include-and-override=portal-${easyconf:companyId}.properties
include-and-override=portal-test.properties
```

Listing B.9: portal.properties override

The set definitions within the portal-ext.properties, which is placed in liferay-portal-[version] /tomcat-[tomcat-version] /webapps/ROOT/WEB-INF/classes, file will override the definitions of the portal.properties file and those changes will be applied to the portal, when starting up the application server.

The complete prototypes' portal-ext.properties, as shown in listing B.10 file, consists all definitions and changes of properties (e.g. database, notifications, mail sessions, user management and login, password reminder) to override in the portal.

```
#
# Stefanie Boruta
#
#-----------------PORTAL-EXT.PROPERTIES
#

#
#--------------------MySQL
#

jdbc.default.driverClassName=com.mysql.jdbc.Driver
jdbc.default.url=jdbc:mysql://localhost/lportal?useUnicode=true&characterEncoding=UTF
    -8&useFastDateParsing=false
jdbc.default.username=liferay
jdbc.default.password=liferay
schema.run.enabled=true
schema.run.minimal=true

#
#--------------------MAIL SESSION
#

mail.session.mail.pop3.host=pop.gmail.com
mail.session.mail.pop3.password=
maÂil.session.mail.pop3.port=110
mail.session.mail.pop3.user=
mail.session.mail.imap.Âhost=imap.gmail.com
mail.session.mail.imap.port=993
mail.session.mail.store.protocÂol=imap
mail.session.mail.transport.protocol=smtp
mail.session.mail.smtp.host=smtp.gmail.com
mail.session.mail.smtp.password=tool2011
mail.session.mail.smtp.user=noreplyProtolife@gmail.com
mail.session.mail.smtp.port=465
mail.session.mail.smtp.auth=true
mail.session.mail.smtp.starttls.enable=true
mail.session.mail.smtp.socketFactory.class=javax.net.ssl.SSLSocketFactory

#
#--------------------PORTAL_CONFIG
#

#
# Configure email/wiki/announcements notification settings.
#
```

```
admin.email.from.name=ProtoLife Admin
admin.email.from.address=noreplyProtolife@gmail.com
company.default.home.url=/home
dl.file.max.size=10240000liferay-portal-[version]/tomcat-[tomcat-version]/webapps
dl.file.extensions=*
announcements.email.from.address=noreplyProtolife@gmail.com
announcements.email.from.name=ProtoLife Admin
announcements.email.to.address=noreplyProtolife@gmail.com
calendar.email.from.address=noreplyProtolife@gmail.com
calendar.email.from.name=Calendar
communities.email.from.address=noreplyProtolife@gmail.com
communities.email.from.name=ProtoLife Admin
#company.login.prepopulate.domain=false
#journal.email.from.address=noreplyProtolife@gmail.com
#journal.email.from.name=Journal System
message.boards.email.from.address=noreplyProtolife@gmail.com
message.boards.email.from.name=ProtoLife Message Boards
wiki.email.from.address=noreplyProtolife@gmail.com
wiki.email.from.name=ProtoLife Wiki
#com.liferay.googlemaps.portlet.GoogleMapsPortlet.api=api.....key.....from.....
    google.....
#wiki.email.page.added.body=test/email_page_added_body.tmpl
#
#--------------------CUSTOMIZED MESSAGES
#

#
# adapted messages from created .jar-file
#

invitation.email.message.body=com/tug/portal/dependencies/email_message_body.tmpl

#admin.email.user.added.enabled=true
#admin.email.user.added.subject=com/liferay/portlet/admin/dependencies/#
    email_user_added_subject.tmpl
#admin.email.user.added.body=com/liferay/portlet/admin/dependencies/#
    email_user_added_body.tmpl
#admin.email.password.sent.enabled=true
admin.email.password.sent.subject=com/liferay/portlet/admin/dependencies/#
    email_password_sent_subject.tmpl
#admin.email.password.sent.body=com/liferay/portlet/admin/dependencies/#
    email_password_sent_body.tmpl

#
#----------------------USER_MGT
#

#users.form.add.main=details,pages

#
# ----------------------PASSWORD REMINDER QUERIES SETTING
#

users.reminder.queries.enabled=true
users.reminder.queries.custom.question.enabled=true

#
# Input a list of valid reminder queries
#

users.reminder.queries.questions=What is the name of your university, What is your
    middle name, What is your pets name, When is your birthday
login.create.account.allow.custom.password=enable

#
#----------------------DEFAULT USER LOGIN
#
```

```
#login.events.post=com.liferay.portal.events.LoginPostAction,com.liferay.portal.events.
    CustomDefaultLandingPageAction
#virtual.hosts.default.community.name=ProtoLife
#admin.default.role.names=User
admin.default.role.names=User
admin.default.user.group.names=ProtoLife
admin.default.group.names=English Language Learning and Training

#
#--------------------MODIFY USERACCOUNTS
#

#
# Remove links from My Account in Control Panel and portlet, just display following to
    the user
#

users.form.add.main=details, password, communities, roles, user-groups
users.form.update.main=details, password, communities,roles, user-groups
users.form.update.identification=addresses,websites,social-network
users.form.update.miscellaneous=display-settings
users.form.my.account.main=details,password,communities,roles
users.form.my.account.identification=addresses,websites,social-network
users.form.my.account.miscellaneous=display-settings

#
# Set the maximum file size for user portraits.
#

users.image.max.size=307200

#
# record last login information for a user
#

users.update.last.login=true

#
#Default User Public Layouts
#

#
# user is not allowed to modify personal pages
#

layout.user.private.layouts.modifiable=false
layout.user.public.layouts.modifiable=false
layout.show.portlet.access.denied=false
users.update.last.login=true

#
#--------------------OPENID
#

#
# Set this to true to enable OpenId authentication. If set to true,then the
# property "auto.login.hooks" must contain a reference to the class
# com.liferay.portal.security.auth.OpenIdAutoLogin.
#

open.id.auth.enabled=false

#
#--------------------TRACKING
#
```

```
#
# tracking via Live Users.
#

live.users.enabled=true

#
#------------------CHAT
#

#
# chats are just possible with friends, not with every member of the portal
#

buddy.list.strategy=friends

#
#------------------WIKI
#

wiki.front.page.name=Wiki
```

Listing B.10: Portal-ext.properties

To give a few examples: the lines shown listing B.11 deny a user within the portal to modify the structure of the personal pages and deny users to add more pages to their personal pages.

```
#
# user is not allowed to modify personal pages
#

layout.user.private.layouts.modifiable=false
layout.user.public.layouts.modifiable=false
```

Listing B.11: Deny customisation of personal pages

Another example shows in listing B.12, that it is just possible for users to chat with friends within the portal.

```
#
# chats are just possible with friends, not with every member of the portal
#

buddy.list.strategy=friends
```

Listing B.12: Chat just with friends

Within the my account portlet, which is for designated users available using the control panel as well, the displayed text boxes for the user data can be modified using the lines presented in listing B.13.

```
#
# Remove links from My Account in Control Panel and portlet, just display following to
    the user
#

users.form.add.main=details, password, communities, roles, user-groups
users.form.update.main=details, password, communities,roles, user-groups
```

```
users.form.update.identification=addresses,websites,social-network
users.form.update.miscellaneous=display-settings
users.form.my.account.main=details,password,communities,roles
users.form.my.account.identification=addresses,websites,social-network
users.form.my.account.miscellaneous=display-settings
```

Listing B.13: Display selected links in portlet

B.2.5 Set Prototype in Production Mode

To install Liferay portal software on a server the following steps need to be done.

Establishing the connection to the TUG server can be either using the nautilus, as shown in figure B.2 or connecting via the command line prompt 'ssh liferay@129.27.200.58' and password.

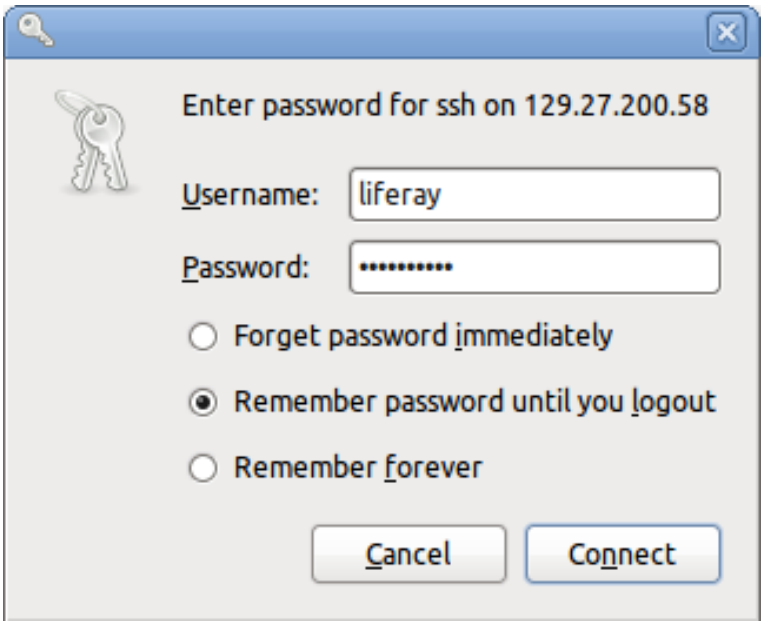


Figure B.2: Connect to server using nautilus

After connecting to the server, the whole local stored Liferay portal folder needs to be uploaded to the designated folder on the server. The prompt listed in listing B.14 will create a copy of the MySQL database.

```
mysqldump -u liferay -pliferay lportal > /laptop/dir/liferay_database.sql
```

Listing B.14: Copy database with mysqldump

The sql file also needs to be uploaded in the MySQL directory of the server. Further some changes in the properties files needs to be done. Within the portal-ext.properties file now located on the server available following the path liferay-portal-[version] /tomcat-[tomcat-version] /webapps /ROOT /WEB-INF /classes the line regarding MySQL data need to be adjusted shown in listing B.15.

```
jdbc.default.username=liferay
jdbc.default.password=liferay1234 -> MySQL password on the server
```

Listing B.15: portal-ext.properties on the server

Further the new path of the application server needs to be inserted in the build.liferay[username].properti
as shown in listing B.16.

```
app.server.dir=/home/liferay/Boruta/liferay-portal-6.0.6/tomcat-6.0.29
```

Listing B.16: portal-ext.properties on the server

After those changes the application server can be started up in the path liferay-portal-[version] /tomcat-[tomcat-version] /bin as illustrated in listing B.17.

```
[liferay@media ~]$ cd Boruta/liferay-portal-6.0.6/tomcat-6.0.29/bin/
[liferay@media bin]$ ./startup.sh
```

Listing B.17: Start application server on server

Finally the portal is ready to use and the prototype is reachable via the URL `http://media.iicm.tugraz.at:8080/` .

Appendix C

CD Content

The implemented prototype, additional information and published papers are burned on a CD-ROM, which is attached to this master's thesis. The CD has the following content:

- The Liferay portal bundled with the used version of Apache Tomcat
- The Liferay Plugins SDK
- The Liferay portal source code
- Screenshots and videos of the prototype in operation mode
- The ICL and iJET publications

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