FAKULTÄT FÜR !NFORMATIK
Faculty of Informatics

Towards a Unified Solution for Course-Related Communication

DIPLOMARBEIT

zur Erlangung des akademischen Grades

Diplom-Ingenieur/in

im Rahmen des Studiums

Business Informatics

eingereicht von

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an der
Fakultät für Informatik der Technischen Universität Wien

Betreuung
Betreuer/in: Ao.Univ.Prof. Dipl.-Ing. Dr.techn. Peter Purgathofer

Wien, 03.05.2013

(Unterschrift Verfasser/in) (Unterschrift Betreuer/in)

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MASTER'S THESIS

submitted in partial fulfillment of the requirements for the degree of

Diplom-Ingenieur/in

in

Business Informatics

by

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Registration Number 0825310

to the Faculty of Informatics
at the Vienna University of Technology

Advisor: Ao.Univ.Prof. Dipl.-Ing. Dr.techn. Peter Purgathofer

Wien, 03.05.2013

(Signature of Author) (Signature of Advisor)

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Danksagung

Ich möchte mich bei all denjenigen bedanken, die mich bei der Erstellung meiner Master Thesis unterstützt haben.

Ein ganz besonderer Dank geht an meine bessere Hälfte, Melissa. Ohne deine Unterstützung, dein Verständnis und deine Zuneigung während der Arbeit an meiner Master Thesis und der Zeit während meines Studiums hätte ich das nicht geschafft. Danke, dass du immer an mich geglaubt hast und mich auch in schwierigen Zeiten dazu ermutigt hast, meine Ziele zu verfolgen und nicht aus den Augen zu verlieren.

Besonders bedanken möchte ich mich auch bei meinen Eltern, Nail und Gazel, die mir das Studium überhaupt ermöglicht haben und mich auf diesem Weg tatkräftig unterstützt und begleitet haben. Auf diesem Weg möchte ich auch noch einmal meinem Vater Nail Kececi für das Korrekturlesen der Arbeit sowie für Empfehlungen bezüglich Literatur über den englischen Sprachgebrauch danken. Ein großes Dankeschön gilt außerdem meinen Geschwistern Michael und Sandra.

Desweiteren möchte ich mich bei Prof. Peter Purgathofer für die umfassende Unterstützung und Betreuung während der Arbeit an meiner Master Thesis bedanken.

Kurzfassung

Es ist essentiell im Rahmen von Lehrveranstaltungen der höheren Bildung online kommunizieren zu können, vor allem für Lehrveranstaltungen mit hoher Teilnehmerzahl und nicht zuletzt aufgrund der Entwicklung von sogenannten Massive Open Online Courses. Diese Arbeit untersucht Aspekte der web-basierten und im Zusammenhang mit Lehrveranstaltungen stehenden Kommunikation, um Probleme und Herausforderungen in eben jenem Bereich zu explorieren. Ein praktisches Projekt wurde entworfen, implementiert und evaluiert, um einen neuen und zeitgemäßen Ansatz in Bezug auf web-basierte Kommunikation in Lehrveranstaltungen zu präsentieren. Diese Arbeit ist auf theoretische Grundlagen und ausführliche Beschreibungen bereits bestehender, relevanter Lösungen fokussiert, wobei Erkenntnisse daraus in Einklang mit Ergebnissen aus einem Explorativem Design Prozess in das praktische Projekt in Form eines Prototypen integriert wurden.

Abstract

The possibility of communicating online within the context of courses in Higher Education is essential, especially for lectures aimed at a large number of students and not least because of the evolution of so-called Massive Open Online Courses. Within this thesis, aspects of web-based, course-related communication are investigated in order to explore the difficulties and challenges in this field of subject. A practical project was designed, implemented and evaluated with the aim of providing a unified and new, contemporary approach to course-related communication. This thesis focuses on theoretical foundations, a detailed state-of-the-art review as well as on design principles derived from Exploratory Research which are, in consequence, integrated into the practical project in terms of a prototype.

Table of Contents

1 Introduction

The most common and popular use of the internet is communication. It occurs via different types of technology, because of a variety of purposes, limited to groups of participants, irrespective of time and space. The way the internet is being used to communicate is exposed to continuous change, especially with the rise of Social Networks over the past decade. In fact, this is considered to be one of the most interesting things about the internet (Thurlow et. al, 2004, p. 1).

This thesis investigates evolution and trends of internet-based communication, predominantly in the scope of higher education. Throughout this document this is referred to as *course-related communication* regarding communication about single courses in higher education. Just like any other kind of communication, course-related communication takes place through different channels by different types of initiation. Common stimuli are informal and organizational exchange of information, announcements, ideas and thoughts. Especially for lectures aimed at a large number of students, the amount of course-related information exchange is difficult to manage, for both students and course instructors.

The focus of this thesis is to explore the difficulties and challenges regarding course-related communication in the context of conceiving, designing, implementing and evaluating a unified and new, contemporary approach to course-related communication. This is accomplished by means of a prototype built within the frame of this research and, in further consequence, integrated into the newest generation of the e-learning framework[1] of the Human Computer Interaction working group of the Institute of Design and Assessment of Technology, Faculty of Informatics, at the Vienna University of Technology.

[1] Called *Portfolio 3.0* and still in development at time of writing this thesis.

The desired outcome of this research is, therefore, to gain further insight into this field of application which might be considered relevant to further investigation and as a basis towards a unified solution for course-related communication. Key aspects regarding the design process of the prototype are the integration of usability concepts derived from Social Networks and Web 2.0 applications. The evaluation of the prototype should indicate whether this approach could be considered valuable for course-related communication by means of improving usability and approvability.

1.1 Motivation

With the wave of Massive Open Online Courses (MOOCs)[1] that started in the fall of 2011, a lot of questions have been raised regarding the relevance of online approaches in higher education. Questions like "Will MOOCs Destroy Academia?" (Vardi, 2012) or "Will massive open online courses change how we teach?" (Martin, 2012) indicate the omnipresent character of MOOCs and the online aspect in higher education. Thus, also course-related communication needs to be investigated within this context.

Traditional forms of course-related communication are known in the appearance of bulletin boards[2], sometimes embedded into e-learning frameworks. Bulletin boards are the forerunners of social networking sites (Lusted, 2011) and with the rise of Social Networks and MOOCs, bulletin boards are getting more and more irrelevant and need to be adapted to the context of higher education. Course-related communication concepts have to be rich in flexibility and usability in order to be applicable to the key contents of MOOCs, e.g. videos, images, lecture slides, tasks and activities. Communication is no longer being pursued within a zoned area of online systems, but rather embedded into every feature and aspect of it. *Facebook*[3] as a classic example of a Social Network already proceeds this approach with its omnipresent *News Feed*[4] that provides the possibility to

[1] MOOCs are online courses provided via the web with open access and are aimed at large-scale participation.

[2] Bulletin boards are platforms, where people can post public messages and are also often referred to as message boards or internet forums.

[3] See http://www.facebook.com.

[4] See https://www.facebook.com/help/327131014036297/.

communicate about different types of content by using the same, transparent and *unified* concept.

According to statistics published by Google (2011), Social Networks and Web 2.0 applications have a large share of the most-visited sites on the web, with Facebook and YouTube on top of the list. Hence, it is reasonable that people are used to concepts and approaches from Social Networks or Web 2.0 applications, respectively, and regard those as common. That implies the relevance to research concerning the integration of Web 2.0 concepts into new designs for course-related communication.

1.2 Limitations and terminology

The reader should be aware of the author's intention of the phrase *unified solution* within this research. On no account does the author want to state that the results of this research should be considered as an ideal solution to the problems of course-related communication defined throughout this thesis. In this context, neither the term *solution* refers to a completed and ready-made application nor the term *unified* refers to a unification beyond the context of e-learning and course- and learning management systems. The research of this thesis addresses communication bound to single lectures and the term *unified* deals with unification of concepts and approaches regarding different types of communication as well as communication about different types of course-related content.

Furthermore, the prototype solution of this research does not contain every detailed aspect, concept or idea derived from the theoretical investigation and state-of-the-art evaluation of this work. Some of those are addressed in Chapter 8, *Outlook*.

1.3 Research method

As already mentioned in the introduction, the focus of this research is to explore the difficulties and challenges regarding course-related communication. Having mentioned that, this task can be considered research into a problem that has not been clearly defined

and therefore affiliates to *Exploratory Research*[1] (Reddy & Acharyulu, 2008, p. 18). The objective of Exploratory Research can be outlined as follows:

> "Exploratory research is performed when the researcher has little information. In other words, an exploratory design is appropriate when the researcher knows little about the problem or opportunity. It is meant to discover new relationships, patterns, themes, ideas and so on. Thus, it is not intended to test specific research hypotheses."
>
> (Hair Jr. et. al, 2008, p. 147)

The term Exploratory Research is often equated with the term of Design Research. Collins et. al (2004) describe Design Research as a method "to test and refine educational designs based on theoretical principles derived from prior research" stating that Design Research is not only aimed at refining practice but as well as addressing theoretical questions and issues regarding effectiveness. As theory and practice are overlapping within the research of this thesis, Exploratory Research or Design Research, respectively, is used as an approach to evaluate the interplay between concepts, principles, theories and problems within the context of course-related communication. Following this exploratory approach, methods such as theoretical investigation, prototyping, qualitative interviews and usability tests are used and will be further described within the following chapters.

1.4 Overview

This thesis is divided into eight chapters.

Chapter 2 provides basic theories, concepts and definitions regarding the field of Computer-mediated Communication (CMC) as basic knowledge of this subject is regarded mandatory for the research of this thesis.

Chapter 3 reflects on CMC within the context of Higher Education discussing the state-of the-art including detailed reviews and evaluations of E-Portfolios, course- and learning management systems and Massive Open Online Courses (MOOCs).

[1] Exploratory Research is often also referred to as Formulative Research or Formative Research.

In Chapter 4, principles and concepts of Social Software and Web 2.0 applications are discussed as they are considered relevant to integration into concepts regarding course-related communication. Particularly, Social Networks (Facebook and Twitter), Social News Aggregators (Digg and Reddit) and Web-based Q&A systems are reviewed and evaluated in terms of usability, interface and interaction design.

In Chapter 5, the practical project within this thesis as already addressed in the Introduction is described. This chapter covers the history of the project, guidelines and feature sets, description of the prototyping process as well as a technical documentation.

In Chapter 6, both the evaluation of the respective prototype and results of qualitative interviews and usability tests are discussed.

Chapters 7 and 8 provide a conclusion of this thesis as well as an outlook on further research and future work.

2 Computer-mediated communication (CMC)

Although the answer to the question of what *Computer-mediated communication* (CMC) means, seems pretty obvious, John December, a long-time associate with Computer-mediated communication and founder and editor of the widely cited website *Computer-mediated communication Magazine*, defines the term as follows:

> "Computer Mediated Communication is a process of human communication via computers, involving people, situated in particular contexts, engaging in processes to shape media for a variety of purposes."
>
> (December, 1997)

As this definition states, CMC depends on contexts, situations and purposes. To understand the use of CMC and the relationship between technology and human communication, a variety of concepts, models and theories have to be considered. This thesis only refers to a selected sub-set of such. For a deeper insight into this field, the author recommends specific literature on CMC that reflects this topic from different points of view, e.g. "Computer Mediated Communication: Social Interaction And The Internet" (Thurlow et. al, 2004), "Computer-Mediated Communication in Personal Relationship" (Wright & Webb, 2010) or "Computer-Mediated Communication: Issues and Approaches in Education" (Kelsey & St.Amant, 2011).

2.1 Theories and concepts

One of the key concepts of understanding computer-mediated communication is *technological determinism*. Chandler (1995) uses the term to refer to the common assumption that technologies are the *primary* cause of:

- major social and historical changes at the *macrosocial* level of social structure and processes; and/or

- subtle but profound social and psychological influences at the *microsocial* level of the regular use of particular kinds of tools.

Based on this concept, Thurlow et. al (2004, p. 41) identify four main assumptions, i.e. that technological determinism:

- reduces the relationship between technology and culture to one of straightforward cause and effect (*reductionistic*),
- oversimplifies an otherwise complex relationship to the effects of a single factor (*monistic*),
- represents technology as neutral or value-free and therefore absolved of "responsibility" (*neutralizing*),
- presents technological "progress" as unstoppable, inevitable, and irreversible (*technological imperative*).

The concept of technological determinism indicates that technology influences the user's behavior. Especially with the rise of Web 2.0 this effect is obvious. Wright & Zdinak (2008, p. 10) even go as far as stating that Web 2.0 is creating a new type of user: the *User 2.0*, which has changed from passive receiver of content into active creator and contributor. This is now a crucial aspect of the internet and a consequence of incentives for CMC that have been identified long time before the emergence of Web 2.0. Palme (2008) outlines some hypotheses on the reasons why people participate in CMC:

- *Status and self-esteem*: Communicating with experts and qualified equals will improve self-esteem and give valuable contacts.
- *Confidence/Competence*: CMC makes it easier to keep up with progress and to avoid sliding behind in your area of expertise.
- *Communion/Comradeship*: CMC stops loneliness and produces a feeling of communion.
- *Inspiration*: CMC provides an exchange of ideas with other people.

- *Generosity*: CMC allows you to help others and feel that others appreciate your help.

In the figurative sense, these thoughts on the incentives of CMC do also fit in with the context of course-related communication. Another crucial concept is the theory of the three *psychosocial roots* of CMC, defined by Riva & Galimberti (1998, p. 4ff):

- *Networked reality*: Exploring the relationship between cognition and interaction, the social system should be seen as a network of relationships providing the *space* (not understood in physical terms only) in which cognitions are elaborated. Two interlocutors are able to influence each other's actions and regulate the nature of their communication through some form of feedback.

- *Virtual conversation*: CMC may be regarded as an example of a more accurately, rarefied form of conversation which lacks the rules on which effective interaction depends.

- *Identity construction*: The subjects, environment and the social context involved in CMC plays a crucial role. New processes and activities will develop which challenge and modify the initial relationship between subject and context.

2.2 CSCW Matrix

The context of use for CMC systems can be represented by the *CSCW matrix*, which is illustrated in *Figure 1* and was first introduced by Johansen (1988). It was actually designed for conceptualizing *Computer-supported cooperative work* (CSCW) systems and considers *time* and *space* (place) as two dimensions in the context of work.

The CSCW matrix, however, also fits in with the context of internet-based course-related communication which is based on course-related tasks, activities or group-based assignments in many cases. The CSCW matrix, in particular, distinguishes between:

- *Face to face interactions*: synchronous and collocated interactions such as decision rooms, single display groupware or wall displays.

- *Asynchronous interaction*: asynchronous and collocated interactions such as team rooms, large public display or project management.

- *Synchronous distributed interaction:* synchronous and distributed interactions such as video conferencing, instant messaging and chats.

- *Asynchronous distributed interaction*: asynchronous and distributed interactions such as emails, bulletin boards, blogs and wikis.

	Same time synchronous	**Different time** asynchronous
Same place collocated	**Face to face interactions** Decision rooms, single display groupware, shared table, wall displays, …	**Asynchronous interaction** Team rooms, large public display, project management, …
Different place distributed	**Synchronous distributed interaction** Video conferencing, instant messaging, chats, …	**Asynchronous distributed interaction** Email, bulletin boards, blogs, wikis, …

Table 1. CSCW matrix by Johansen (1988).

Looking at the concepts of the CSCW matrix, the strong connection to course-related communication and Web 2.0 seems obvious. A deeper insight into the coherence between CSCW and Web 2.0 is provided by an edited collection of selected papers under the title "From CSCW to Web 2.0: European Developments in Collaborative Design" (Randall & Salembier, 2010).

2.3 Criticism of CMC

A close parallel to the evolution of CMC more and more criticism and issues on CMC are emerging, following discussions about privacy and security leading the way. But there are a lot more concerns in the field of CMC and Web 2.0.

> "Remember, what always interests us in CMC is social interaction, and this is all about identity, relationship, and community."
>
> (Thurlow et. al, 2004, p. 81)

The above statement accurately outlines the foundation of issues about CMC. Within this thesis, only a few, selected issues covered by Thurlow et. al (2004, p. 81-147) are being considered relevant to the research of this thesis and are summed up in the following list:

- *Various circumstances in geographical regions* regarding costs of getting online and the freedom of communication.
- *Online ethics* regarding what is right and what is wrong in the context of CMC (e.g. defined by the *ACM Code of Ethics*).
- *Inequalities* regarding differences in language, gender, age, physical ability, race and ethnicity.
- *Online identity and Online communities* regarding the differentiation between what is real and what is virtual/imagined.
- *Online compulsion and addiction*.

3 CMC in Higher Education: State-of-the-art

In this chapter, some solutions and concepts considered relevant to the support of computer-mediated communication in higher education are being outlined and evaluated. The reader should note that the following review does not regard all substantial aspects of the respective solutions but rather focuses on the evaluation of usability concepts and approaches to online communication concerning the respective solutions. Furthermore, the evaluation should reveal possible approaches to improving course-related communication and manifest differences in functional principle and usability between common and emerging solutions for course-related communication.

3.1 E-Portfolios

E-Portfolios are websites for self-projection that are individually designed and worked-up to present work and projects in a situational context (Luckner, 2011, p. 33). Within the scope of higher education, E-Portfolios could be used for presenting and collecting assignments, project works or theses.

Villano (2006) differentiates between *developmental, reflective* and *representational* e-portfolios:

> "A developmental e-portfolio comprises a record of assignments over time, a reflective e-portfolio includes personal reflection on the content as well. A representational e-portfolio shows achievements in relation to particular work or developmental goals and is, therefore, selective."
>
> (Villano, 2006)

Based on the needs of institutions and departments, all three types of E-Portfolios might be taken into consideration in higher education. With the clarification of needs, Reese & Levy (2009, p. 6) identify a set of benefits for *Senior Leaders, Faculty, Students* and *Administrative/Support Departments* when using E-Portfolios in higher education.

Senior Leaders	▪ Facilitate internal and external departmental review. ▪ Support broader institutional assessment for accreditation and other purposes.
Faculty	▪ Assist faculty in writing letters of recommendations for students. ▪ Facilitate student advising. ▪ Support internal and external departmental review. ▪ Archive student coursework.
Students	▪ Archive student coursework, research, internships, and extracurricular activities. ▪ Promote student reflection on academic and professional goals. ▪ Facilitate student advising and career counseling. ▪ Present accomplishments to potential employers and admissions officers.
Administrative/Support Departments	*Advising* ▪ Facilitate student advising. ▪ Faculty/staff can reference this information when writing letters of recommendation. ▪ Support pre-professional advising process by archiving students' academic and extracurricular data. *Career Services* ▪ Facilitate student career counseling. *Development/Alumni Relations* ▪ Maintain connections and build relationships with alumni.

Figure 1. Possible benefits when using E-Portfolios in higher education, identified by Reese & Levy (2009, p. 6).

One approach to the use of E-Portfolios in higher education is *The Radical Portfolio* introduced by Purgathofer (2010) and used at the Vienna University of Technology. It is established on the idea of having no assignments, no deadlines, no exams or test and no *game of school*[1]. *The Radical Portfolio* is the foundation of current research on e-learning and course communication at the Human Computer Interaction working group of the Institute for Design and Assessment of Technology at the Vienna University of Technology. Furthermore, it is prior to the research in the scope of this thesis. The prototype built within the research of this thesis is being integrated into an e-learning framework which is built upon *The Radical Portfolio*.

The Radical Portfolio consists of a catalog of possible "activities" that students can choose freely and accomplish using their online portfolios. Such activities are not being valued

[1] Reference to the book „The Game of School: Why We All Play It, How It Hurts Kids, and What It Will Take to Change It" by Robert L. Fried.

with more than 10% of the final grade, most activities are valued with less than 5% of the grade. Furthermore, there is a hand-in limit per week and the possibility to improve certain submissions by receiving bonus points. Students can comment on the Question & Answer section of activities, as shown in *Figure 2*, as well as on their private submissions. This is also the place for tutors to leave reviews and feedback on submissions or to discuss certain aspects of submissions. Apart from this, there is a public newsfeed for general questions, discussions or announcements.

Figure 2. Question & Answers section for activities in *Portfolio 2.0*, a further development based on the idea of *The Radical Portfolio,* at the Vienna University of Technology.

Another crucial module of *The Radical Portfolio* is the *Slidecasting Studio*. It provides students with the possibility to comment on slides during class and out of class. Purgathofer's research showed that approximately the half of all comments on slides was made during class. All slides including all comments, distinguished by public and private notes, are then available in the portfolio after the lecture as shown in *Figure 3*.

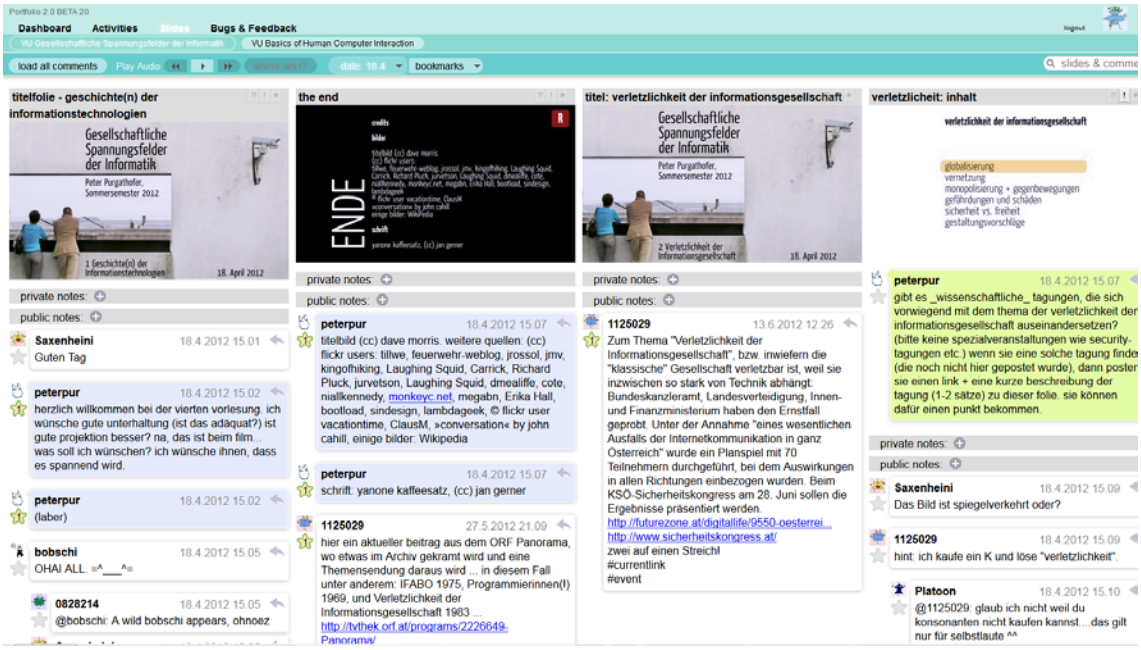

Figure 3. Slidecasting Studio with public and private notes in *Portfolio 2.0* at the Vienna University of Technology.

3.2 Course- and Learning management systems

According to Avgeriou et. al (2003), learning management systems (LMS) are learning systems in order to provide education and training following the open and distance learning paradigm. Such systems incorporate in a variety of organizational, administrative, instructional and technological components and thus have to provide interfaces for students, teachers, tutors and administrators (Luckner, 2011, p. 29).

The aspect of *learning* is essential in the context of learning management systems as the term LMS is commonly associated with the term course management system (CMS) and vice versa. Watson & Watson (2007) define the characteristics of a CMS as providing a course instructor with a framework for creating online course content and the subsequent teaching and management of that course including interactions with students. Hence, a

CMS is not necessarily bound to *learning* as an LMS or LCMS (learning content management system) is. According to Oakes (2002) an LCMS is a system used for generating personalized e-learning content in the form of learning objects whereas an LMS is concerned with managing learners and learning activities. That implies that LCMS and LMS have a different focus but integrate well.

However, the author of this thesis does not distinguish between CMS, LMS and LCMS in the scope of this research. So, the subsequent evaluation of common characteristics of course- and learning management systems does not make any distinction between CMS, LMS and LCMS and is not focused on e-learning but rather on online communication. Furthermore, the evaluation is based on a specific selection of such systems and should provide an overview of concepts of usability and communication for well-established as well as newer approaches.

3.2.1 Moodle, TUWEL and TISS

Starting with one of the long established learning- and course management systems, *MOODLE* is considered one of the most popular solutions in this field. It was first released by Martin Dougiamas in 2002, stands for *Modular Object-Oriented Dynamic Learning Environment* and is an open source project used in lots of universities and schools.

> "The design of *Moodle* is based on socio-constructivist pedagogy. This means its goal is to provide a set of tools that support an inquiry- and discovery-based approach to online learning. Furthermore, it purports to create an environment that allows for collaborative interaction among students as a standalone or in addition to conventional classroom instruction."
>
> (Brandl, 2005)

Since 2006, the Moodle-based platform *TUWEL* (TU Wien E-Learning) is being used at Vienna University of Technology[1]. It is linked to the University's internally developed information system *TISS*[2] (TU Wien Informations-Systeme und Services) and its user

[1] See http://teachingsupport.tuwien.ac.at/tuwel/ and https://tuwel.tuwien.ac.at/my/.

[2] See http://www.zid.tuwien.ac.at/ueber_tiss/ and https://tiss.tuwien.ac.at.

management. TUWEL supports features such as activities, assignments, message boards, coordination of dates and group registrations. In TUWEL, course material and assignments are usually grouped by blocks of lectures with a "general" block on top of the page. *Figure 4* illustrates the structure of a TUWEL course whereas items with a PDF-icon indicate course slides and items with a notepad-icon indicate assignments. At the top of the page the announcements forum is linked which is encapsulated from slides or assignments. The message forums in TUWEL are structured as common bulletin boards, as shown in *Figure 5*. That topic will be discussed in more detail at the end of this chapter.

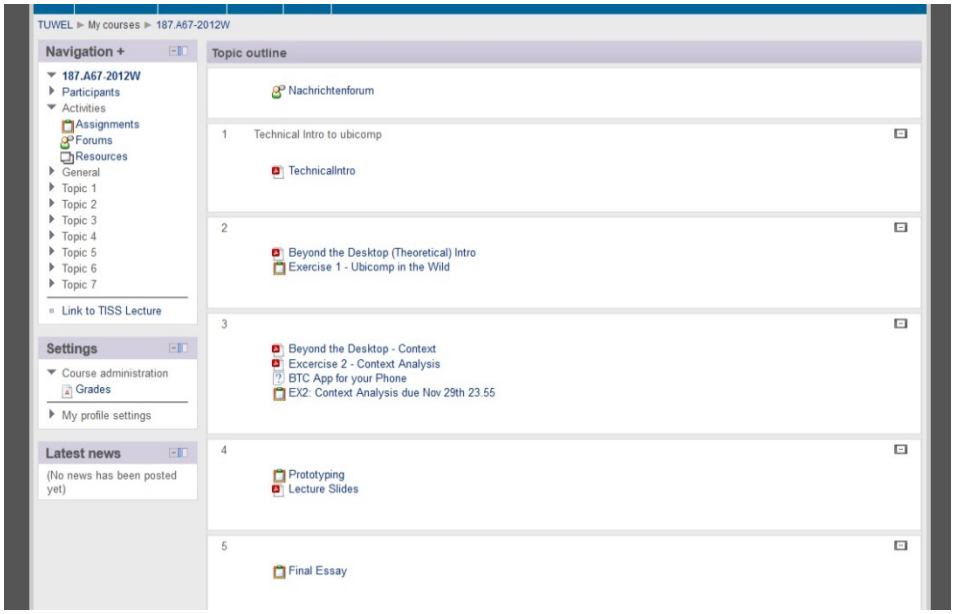

Figure 4. Starting page of a TUWEL-course at Vienna University of Technology.

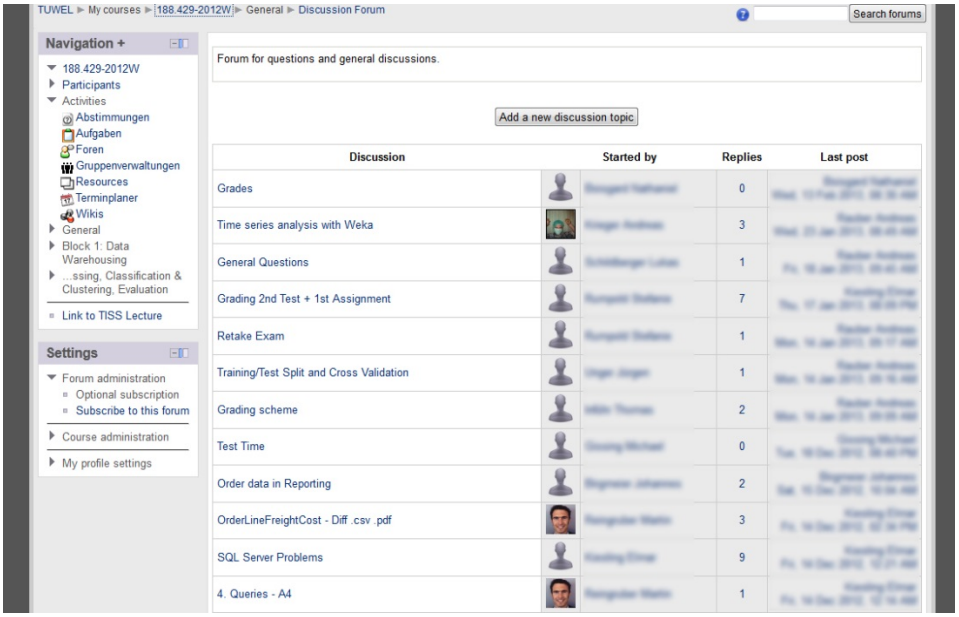

Figure 5. Structure of a message forum of a TUWEL-course at Vienna University of Technology.

In addition to message forums, the author of this thesis identified two further communication channels that are used in TUWEL. Firstly, the channel for submissions where course instructors are able to provide feedback on student's submissions, as shown in *Figure 6*. The author wants to note that considering personal observations of the use of this feature, course instructors rarely provide feedback on student's submissions in TUWEL and students are usually not able to react or comment on feedbacks, so this channel, if used at all, is only designed for unidirectional communication.

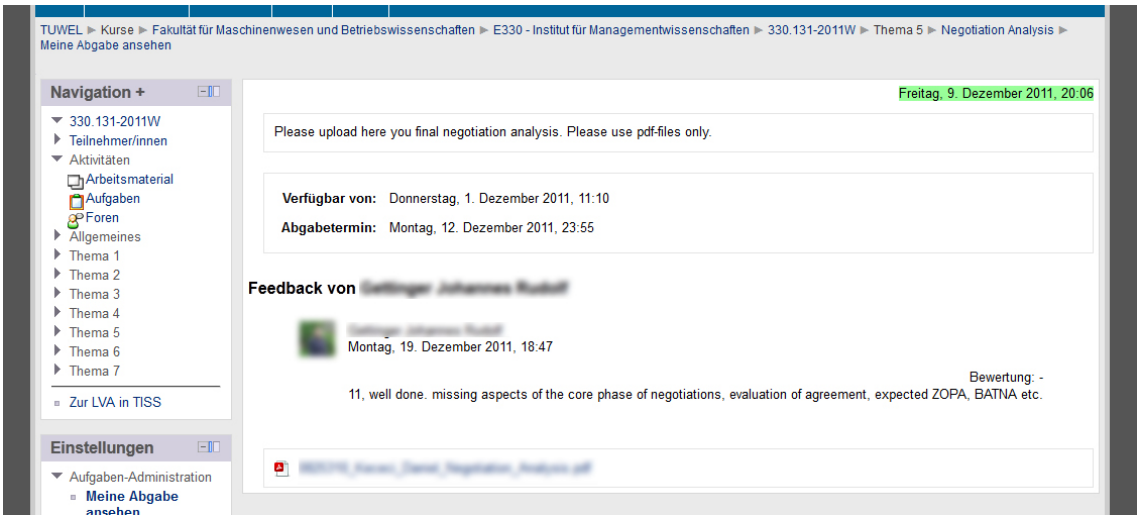

Figure 6. Feedback on a submission of a TUWEL-course at Vienna University of Technology.

Secondly, there is TUWEL's *messaging system*, which works beyond the scope of single courses and is designed for the use of private messages. However, this feature is often used by course instructors as a channel for announcements instead of announcement forums of respective courses, as shown in *Figure 7*. Using this feature this way, a private message is generated from the respective course instructor to each subscriber of a respective course. The announcement will not be globally available, unless it is redundantly posted in an appropriate message forum as well. Furthermore, students are hypothetically in a position to respond to such announcements resulting in a variety of questions, feedback and remarks that are not globally available for a respective course.

Additionally, also TISS has built-in message boards, as shown in *Figure 8*, and announcement sections, as shown in *Figure 9*. This is reasonable because there are certainly courses that might not be assisted by TUWEL. But in the case of using TISS as well as TUWEL this aspect is crucial. Students tend to use message forums on both platforms, even with duplicated content. Similarly, course instructors use different ways

to establish communications within the same course, e.g. by using TISS' news section for announcements by professors and TUWEL's messaging system or announcement forums for announcements by tutors.

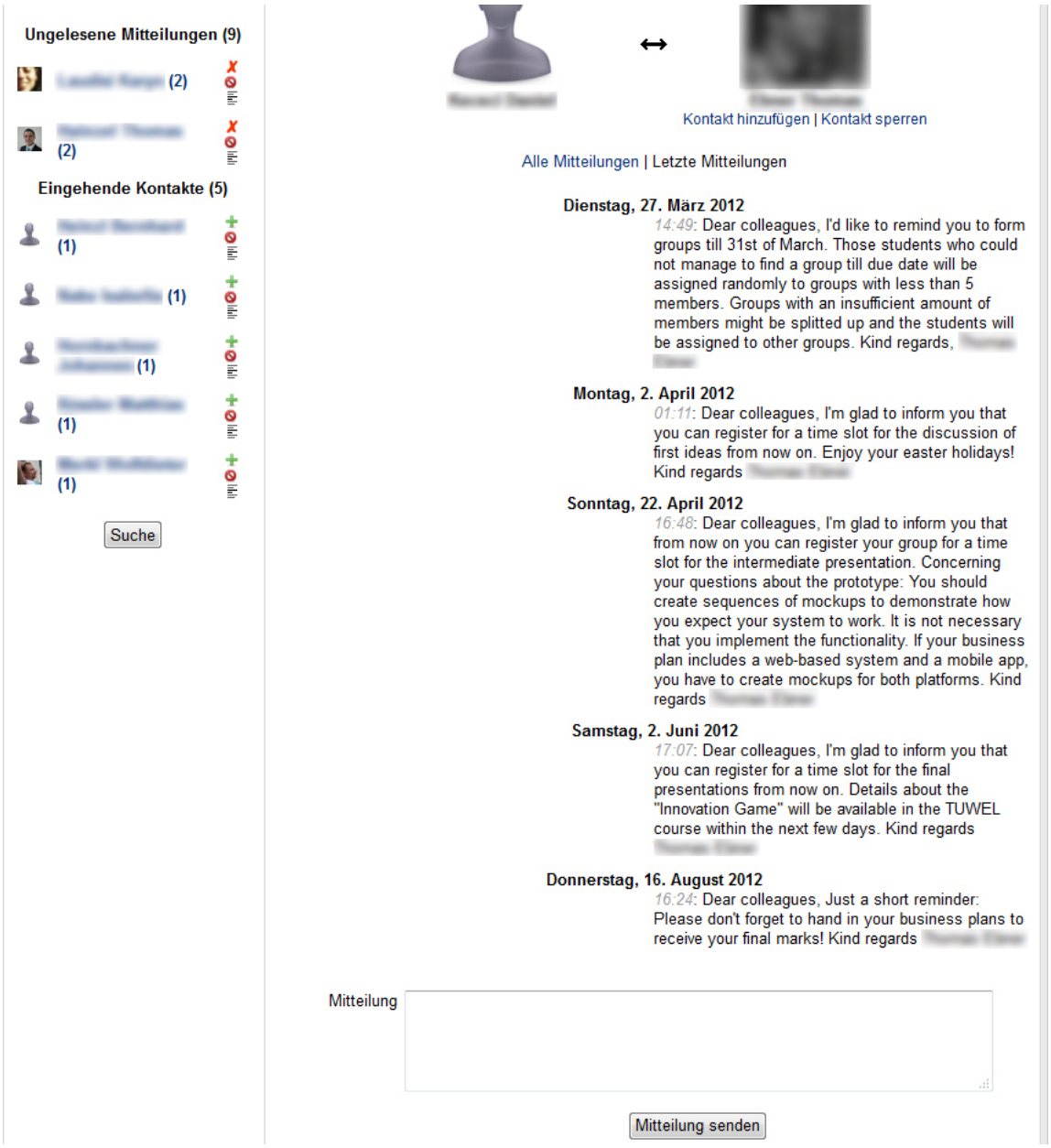

Figure 7. Messaging system of TUWEL used for announcements of a course. Note that all conversations displayed in the box on the left side are announcements by course instructors.

On top of that, announcements and messages by course instructors on both platforms, TUWEL and TISS, might also generate e-mails with exactly that specific content which are sent to all subscribers of a respective course resulting in a variety of questions, feedback

and remarks by students sent via e-mail that again are not globally available for a respective course.

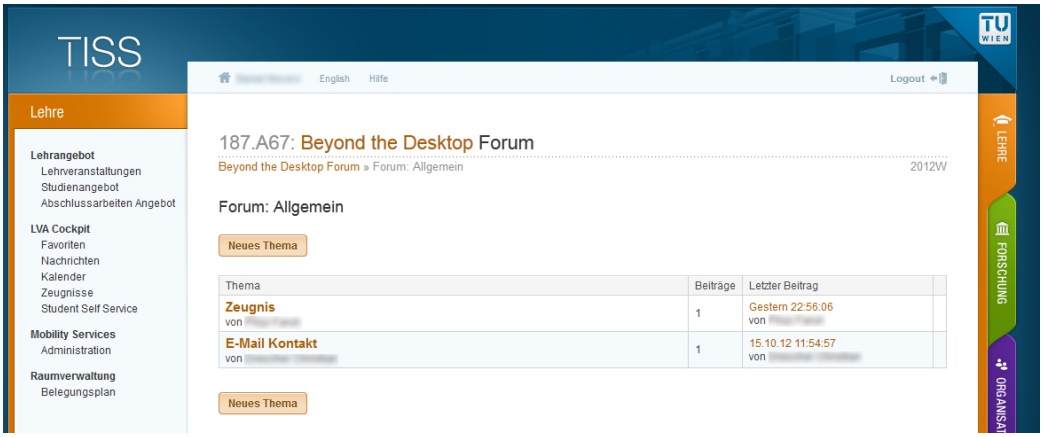

Figure 8. Message forums of a TISS-course at Vienna University of Technology.

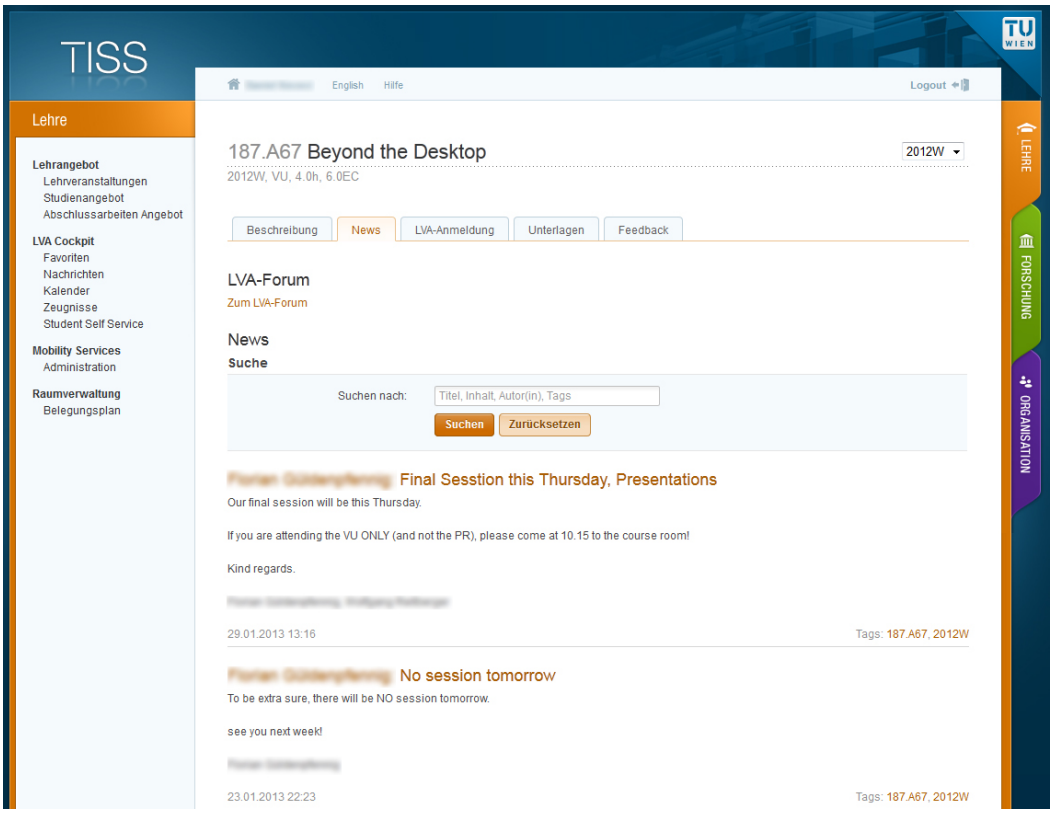

Figure 9. Announcement section of a TISS-course at Vienna University of Technology.

In short, this critical evaluation of TUWEL and TISS as a classic example shows that communication mediated via common course- and learning management systems does not occur in a unified way. Communication takes place on different platforms, via different channels using different usability approaches. As an appendix to this chapter, the author wants to elaborate on commonly occurring usability approaches and structures

for message forums of course- and learning management systems such as TUWEL and TISS. The author has noticed that not only these specific message forums but message forums of course- and learning management systems in general usually rely on deep site hierarchies, i.e. a forum structure with few categories but more levels which requires more clicks to get to the bottom (Krug, 2006, p. 41). Wide site hierarchies, in contrast, are broken into more categories at each level but have fewer levels which require fewer clicks to get to the bottom. Regarding message boards and other interactive communication systems, wide site hierarchies are used especially in Web 2.0 applications. Here, in many cases there is only one level with a variety of categories in form of tags and filters. Common message forums such as the ones used by TUWEL or TISS display the different types of forums (e.g. announcement forums, discussion forums) at the first level, the respective "threads" of these forums at the second level and the messages of a thread in the first level. The user has to click two times to actually see messages of a certain topic. Furthermore, the user has to click for a third time to compose an answer to a certain topic. Each click usually initiates a reload of the complete page, even though content of only a few parts of the page is changed.

3.2.2 Excursus: AJAX

Considering observations by the author of several systems using message boards in higher education, contemporary web approaches like *AJAX,* which stands for Asynchronous JavaScript and XML, are barely used. AJAX is a client-side technique for creating asynchronous web applications, i.e. applications that can send and receive data to/from a server asynchronously. AJAX is often associated with the terminology of Web 2.0 since many Web 2.0 applications have been showing their advantages by the use of AJAX.

> "Ajax web development gives you everything you need. And what makes Ajax special is that it is not a new technology - it is the combination of many technologies that have been around for a while and that are production-tested. User interaction, fast response time, desktop-like features: web applications are no longer something that you can only dream of for the future. Web applications are in the here and now. Welcome to Web 2.0 with Ajax."
>
> (Holdener III, 2008, p. 21)

3.2.3 Piazza

New approaches to web-based course communication are rather integrated with the use of AJAX and therefore preferably associated with Web 2.0. An example of that is *Piazza*[1]. Piazza is a mixture of a wiki and a forum (Kincaid, 2010) with the character of a Question & Answer system. Its request architecture is based on AJAX indicating short response times. It fits well in with the definition of Web 2.0 applications and focuses on learning by collectively constructing posts and answers. The Piazza platform is structured as shown in *Figure 10*.

> "Students post questions to their course page, which peers and educators can then respond to. Instructors moderate the discussion, endorse the best responses and track the popularity of questions in real time. Responses are also color-coded, so students can easily identify the instructor's comments."
>
> (Rusli, 2011)

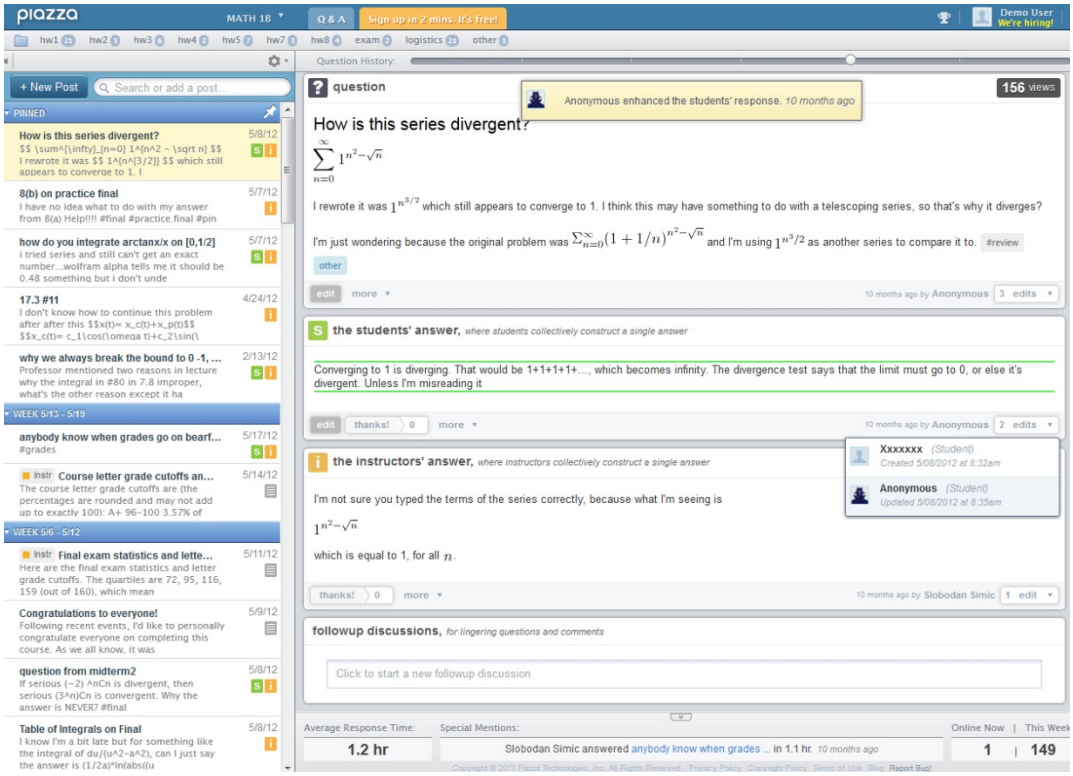

Figure 10. Overview of a Piazza-assisted course and the structure of the Piazza platform.

[1] See http://www.piazza.com.

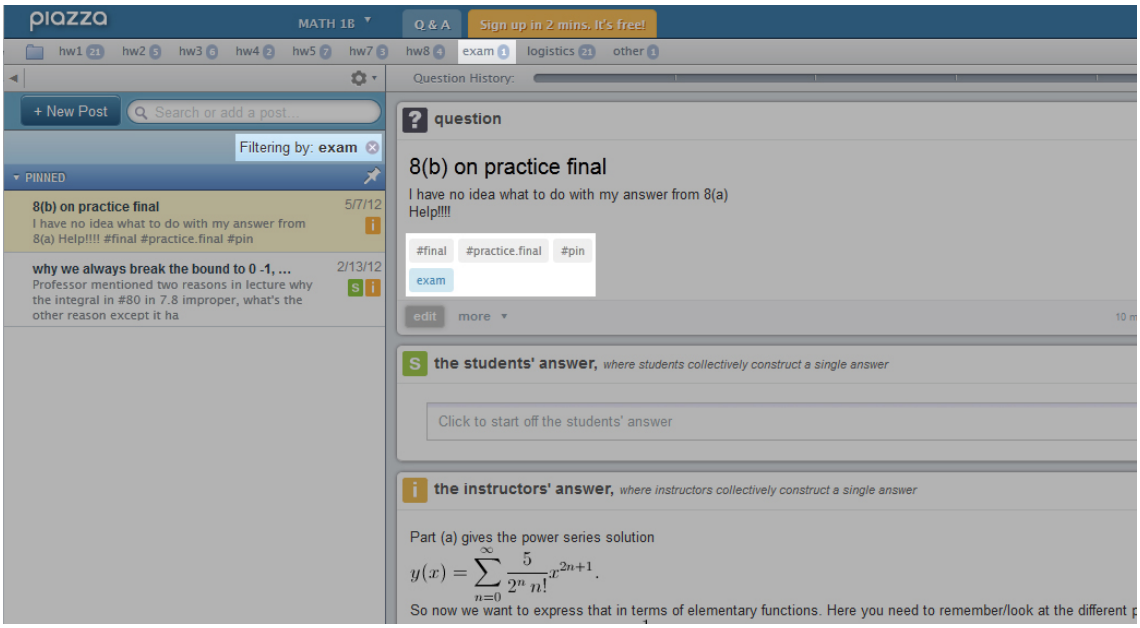

Figure 11. Use of „filters“ to flag topics in Piazza.

As *Figure 11* illustrates, topics can be filtered by specific flags. The associated filters are displayed beneath the message of a topic's starting post and can be considered tags. Furthermore, topics might also include hash tags, represented with a prepending hash character. In contradiction to filters which are predefined in Piazza, tags can be chosen freely and are, therefore, characterized in terms of a folksonomy. According to Albrecht (2006, p. 1), a folksonomy is a social network that arises from the activity of *Free Tagging*, i.e. users flag objects with freely chosen tags in order to retrieve such objects referred to those tags. Besides the selectable filters on the top bar there are filters that are generated by means of the system's use. These filters include e.g. unread, updated or unresolved topics and are applicable through the "preferences"-icon on top of the left column.

Further categorization of topics and posts is managed via icons. *Figure 10* and *Figure 11* show that topics and posts are linked to appropriate icons, e.g. green and yellow icons with the labels "S" and "i" indicating whether a post is collectively constructed by students or by course instructors. Other categorical icons indicate the type of a topic or a post, e.g. icons for the types "note" or "question".

As stated above, in Piazza students as well as course instructors are able to answer questions collectively by editing and complementing already existing posts with a similar approach to the one established in the context of wikis. Therefore, the system provides specific interfaces and views for historization for question and answers, as shown and

highlighted in *Figure 12*. At the top of each topic there is the history slide bar which provides the opportunity to review the development of posts. Furthermore, each post can be displayed as is before specific edits.

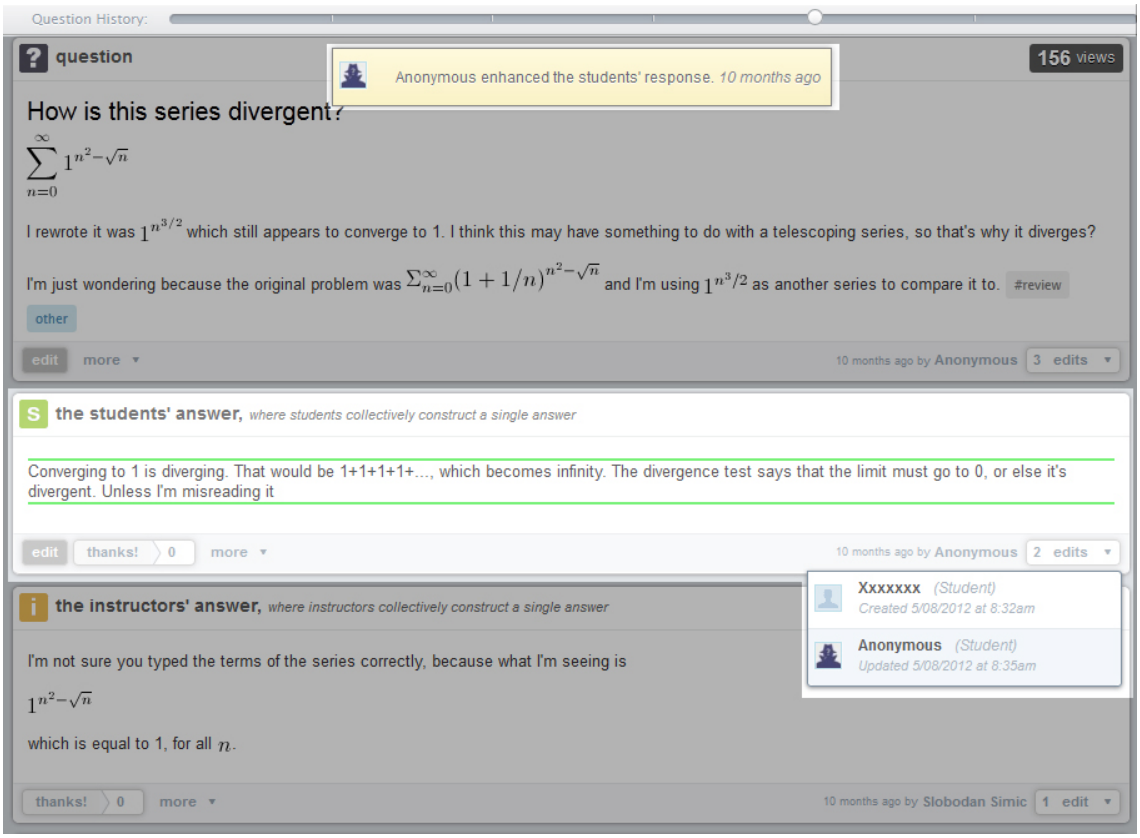

Figure 12. Features for viewing historization of posts in Piazza.

Generally, Piazza is heavily built upon different types of metadata. These include filters, tags, categorically icons as well as time-based and automatically generated types of classification. Most of these metadata are used for retrieving and aggregating topics and posts efficiently but some are also used for only indicating further information about topics and posts. So is the "Thanks"-buttons. If users of the system like specific posts, they can express this by using the "Thanks"-button. Other users can then see how many and which users appreciated specific posts. This concept of "liking" content by others is most famously known by Facebook's *Like* which Facebook describes by the phrase "Give positive feedback and connect with things you care about"[1].

[1] See https://www.facebook.com/help/452446998120360/.

3.3 Massive Open Online Courses

The term *Massive Open Online Course* can best be described within the context of its first use. The term was first introduced by Dave Cormier in 2008, as a description of the course "Connectivism and Connective Knowledge" that was co-taught by George Siemens and Stephen Downes to 25-tuition-paying students at the University of Manitoba as well as to approximately 2.300 students from general public via online class at no cost (Thompson, 2011, p.1; Yuan & Powell, 2013, pp. 5-6).

> „As its name suggests, a massively open online course (MOOC) is a model for delivering learning content online to virtually any person - with no limit on attendance - who wants to take the course."
>
> (Thompson, 2011, p. 1)

Similarly, as far as the approach of *The Radical Portfolio* described in Chapter 3.1 is concerned, MOOCs are intended for meeting the requirements of a large-scale audience. Likewise, students can choose their level of participation by themselves and the majority of course-related activities and communication is handled online. The main difference between MOOCs and the approach of *The Radical Portfolio,* though, is that MOOCs are available and open to everyone. The "open" students do not pay for participating and might join in some or all of the course activities. However, in the context of MOOCs, "open" does not only mean "free" and therefore should not be equated only with "free".

> "Often mistakenly equated only with "free," open education advocates are working towards a common vision that defines "open" as free, copyable, remixable, and without any barriers to access or interaction."
>
> (Johnson et. al, 2013, p. 7)

Besides the concept of openness, MOOCs are characterized through scalability, i.e. MOOCs are designed to support an indefinite number of participants (Yuan & Powell, 2013, p. 6) using technologies and publication mediums such as wikis, blogs, videos, discussion boards and academic websites (Thompson, 2011). According to Thompson (2011, p. 2) MOOCs cause "a new learning dynamic, one that offers remarkable collaborative and conversational opportunities for students to gather and discuss the

course content" but also has its downsides such as making "some students uneasy, particularly those who expect or thrive on a high level of contact with the instructor". Yuan & Powell (2013, p. 7) distinguish MOOCs between cMOOCs which are based on connectivism theory of learning[1] and xMOOCs which are based on behaviourist theory of learning[2].

> "cMOOCs emphasise connected, collaborative learning and the courses are built around a group of like-minded 'individuals' who are relatively free from institutional constraints. cMOOCs provide a platform to explore new pedagogies beyond traditional classroom settings and, as such, tend to exist on the radical fringe of HE [Higher Education]. On the other hand, the instructional model (xMOOCs) is essentially an extension of the pedagogical models practised within the institutions themselves, which is arguably dominated by the "drill and grill" instructional methods with video presentations, short quizzes and testing."
>
> (Yuan & Powell, 2013, p. 7)

Although MOOCs provide open access to everyone that does not mean that they are not-for-profit. On the contrary, MOOCs rely on specific business models. Yuan & Powell (2013, pp. 9-10) state that the most common revenue stream for major MOOC providers is to charge fees for certificates. However, there are a lot of other potential revenue sources that are for instance used by two of the most popular MOOC providers, Coursera[3] and Udacity[4]. Yuan & Powell (2013, pp. 9-10) list the following potential business models among others:

- Certification
- Employee recruitment (selling student information to potential employers)
- Fee-based assignment grading

[1] Theory of networked learning which focuses on learning as making connections.

[2] Theory of learning as the acquisition of new behaviour through conditioning.

[3] MOOC provider with 62 partner universities (status in 03/2013), see https://www.coursera.org/.

[4] MOOC provider that started with computer science courses by Stanford University, see https://www.udacity.com/.

- Supplied training courses for own enterprises
- Sponsored high-tech skills courses
- Access to social networks and discussions
- Applicant screening
- Tuition fees

Subsequently, three of the most popular MOOC providers[1] – Coursera, Udacity and edX[2] - are evaluated and reviewed concerning usability concepts and approaches for online communication. The reader should note that, overall, all of the three providers are based on similar concepts and structures, therefore the subsequent evaluation and review should imply that other MOOC providers not mentioned within this thesis can be regarded as likewise and are not considered within the research of this thesis. During research, the author of this thesis has signed up for several courses within all of the three MOOC providers for testing purposes. Furthermore, the subsequent evaluation and review is focused on web-based aspects of the MOOC providers and does not elaborate on communication via email that might also be pursued by MOOC providers. However, the author of this thesis has observed heavy use of emails especially in Coursera, for example for welcome emails, weekly updates, study groups, assignments and deadlines regarding specific courses. Reflecting on the concept of openness, services by these MOOC providers are free (except for previously mentioned business models) with the necessity of signing up to the provider's websites first and to potential courses later as the main barrier to access or interaction. Provided content is partially intended for copying (course material and video streams rather than forum discussions) whereas only in some cases content is intended for remixing, e.g. for questions and answers in discussion forums where posts can be created collectively. Such examples are further described in the following reviews of the three MOOC providers.

[1] See http://www.nytimes.com/2012/11/04/education/edlife/the-big-three-mooc-providers.html (accessed 03/2013)

[2] MOOC platform founded by Massachusetts Institute of Technology (MIT) and Harvard University, see https://www.edx.org/.

3.3.1 Coursera

Coursera describes itself as "a social entrepreneurship company that partners with the top universities in the world to offer courses online for anyone to take, for free."[1] It is possible to explore courses by category, University and language[2]. On Coursera's starting page there is an overview of courses the user has signed up for as well as courses that are starting soon. Each course is structured individually with varying navigation menus and types of activities. The starting page of a course usually consists of announcements and upcoming deadlines, as shown in *Figure 13*.

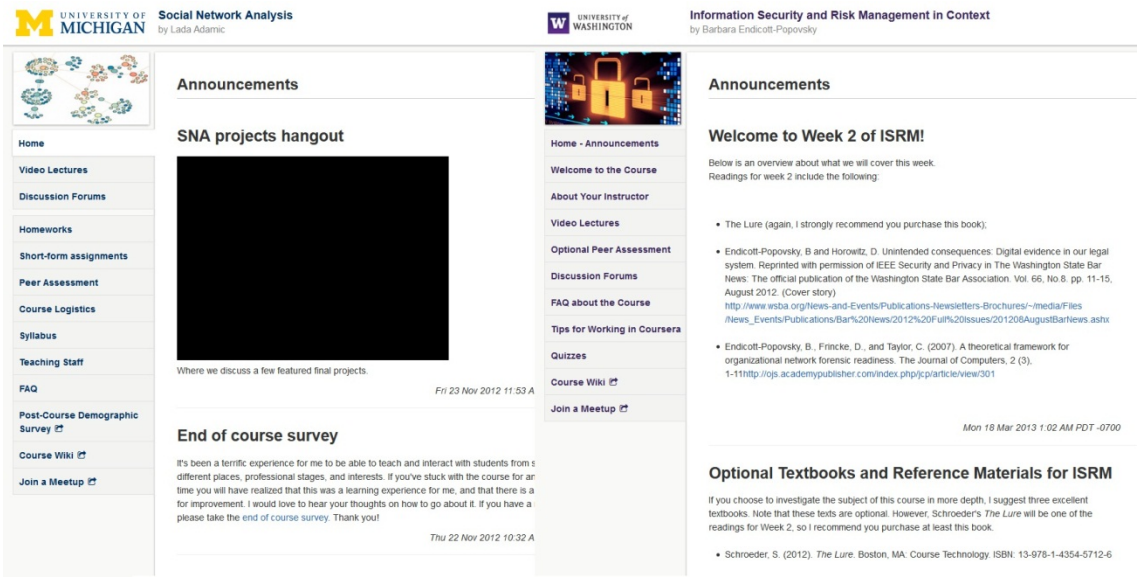

Figure 13. Starting page and navigation menu of courses in Coursera.

Courses in Coursera heavily rely on video lectures which are composed of actual video streams, embedded lecture slides, subtitles and integrated, short quizzes. Such video lectures are divided into lecture weeks and sub-topics with the possibility to link material to each lecture or sub-topic such as the video stream, lecture slides and subtitles, in particular, as well as the relevant literature. The structure of available video lectures in Coursera is illustrated in *Figure 14*. On the basis of courses that the author of this thesis has signed up for in the scope of this research, it is safe to say that courses in Coursera usually provide a course wiki, discussion forums and FAQs[3]. Such FAQs are put together individually in a static way and not by means of auto-collecting "hot topics" of respective

[1] See https://www.coursera.org/about.

[2] English, Spanish, French, Chinese and Italian (accessed 03/2013).

[3] Frequently Asked Questions.

sub-forums of the discussion forum. Discussion forums in Coursera are structured like common bulletin boards. There are several sub-forums that divide the forum content-wise, e.g. into sub-forums with titles like “general discussions”, “technical feedback”, “lectures” and “assignments”.

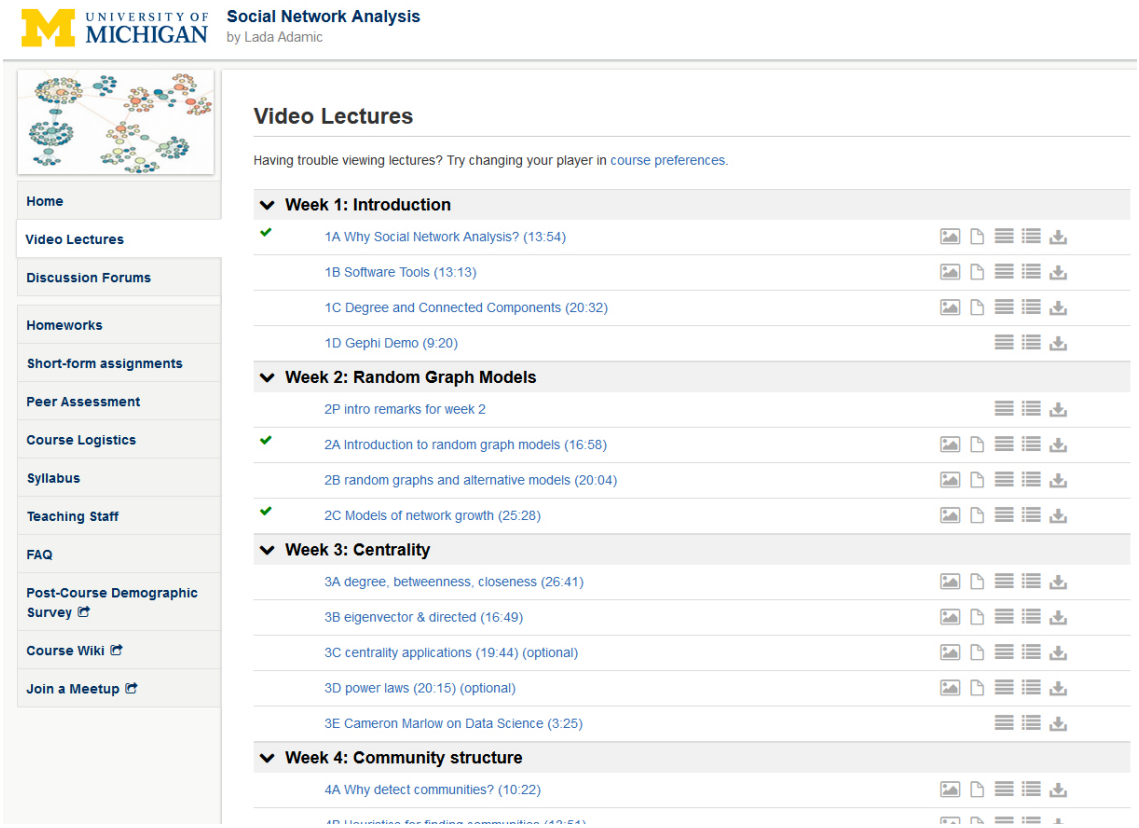

Figure 14. Structure of the „video lectures“ site of a course in Coursera.

Within a sub-forum several filters can be applied for retrieving threads/topics. By default, “top threads” are listed, further filters are “last updated”, “last created” and “subscribed”. Users can subscribe to specific sub-forums as well as to specific topics/threads and receive e-mail updates for new activity in such forums or threads in consequence. Topics provide their title, the name of the starter, the name and date for the last reply as well as some additional information including labels for e.g. “unresolved”, “staff reply” and “pinned” (topics that are always on top of the list), the number of replies, the number of views and the number of votes. Regarding the votes, it might seem unclear at first whether the number indicates the actual number of votes or the average value of votes since users can vote up (+1) or vote down (-1). However, the number displayed indicates the average value of votes. The structure within a sub-forum in Coursera is displayed in *Figure 15*.

In addition to that, topics can be flagged with tags. These tags are not displayed within the overview of topics. Students can freely add tags to or remove them from topics and in consequence retrieve all topics linked to specific tags which corresponds to the principle of folksonomy, as already described in Chapter 3.2.

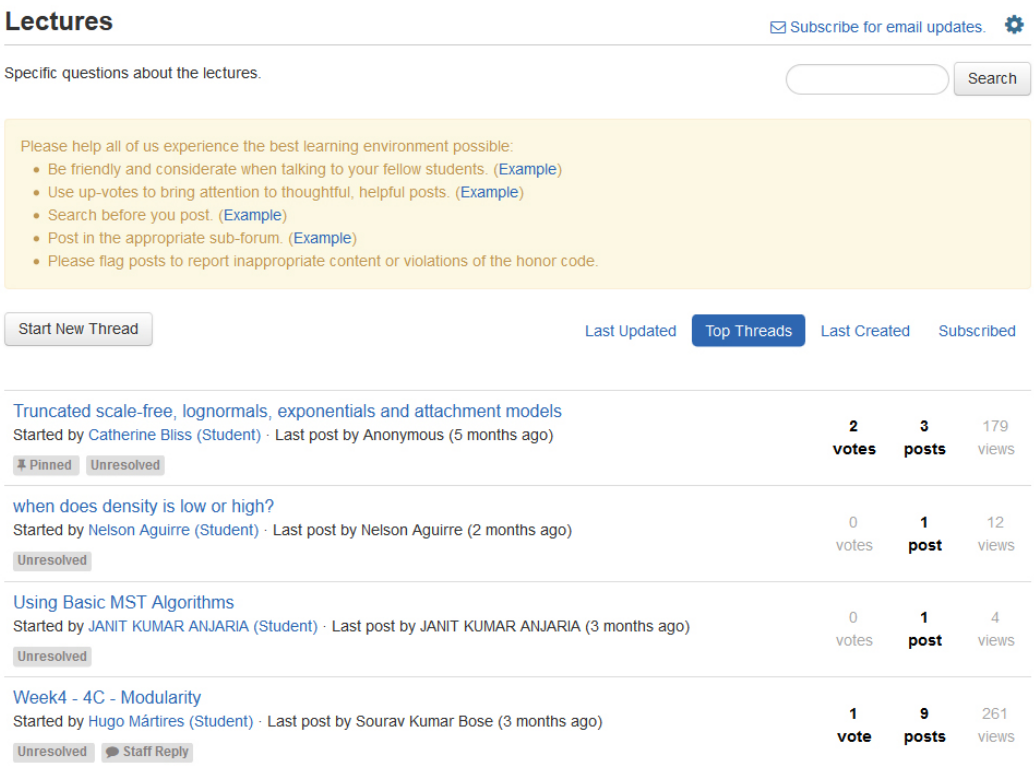

Figure 15. Structure of a sub-forum of a course in Coursera.

Replies or comments within a topic are displayed by two levels of hierarchy, i.e. replies to the thread resulting in comments that are displayed hierarchically on the same level as the starting post as well as replies to those specific posts that are displayed hierarchically one level deeper, as shown in *Figure 16*.

As regards content, discussion forums in Coursera are used for general and public kinds of communication. Announcements that are being displayed on the starting page of each course are not part of the discussion forum and therefore not open for feedback. Although in most cases there are specific sub-forums for assignments, exams and lectures these forums are not systematically linked to respective types of content. For example, the possibility for commenting on a submission right on the same page where its description is being displayed is not being provided. Concerning the concepts of usability, Coursera's discussion forums can be regarded as commonly structured bulletin boards with the integration of some Web 2.0 concepts such as tags, votes and filters. The Web 2.0

character is being strengthened through the use of AJAX and the CSS framework *Bootstrap* which is known and developed by Twitter[1].

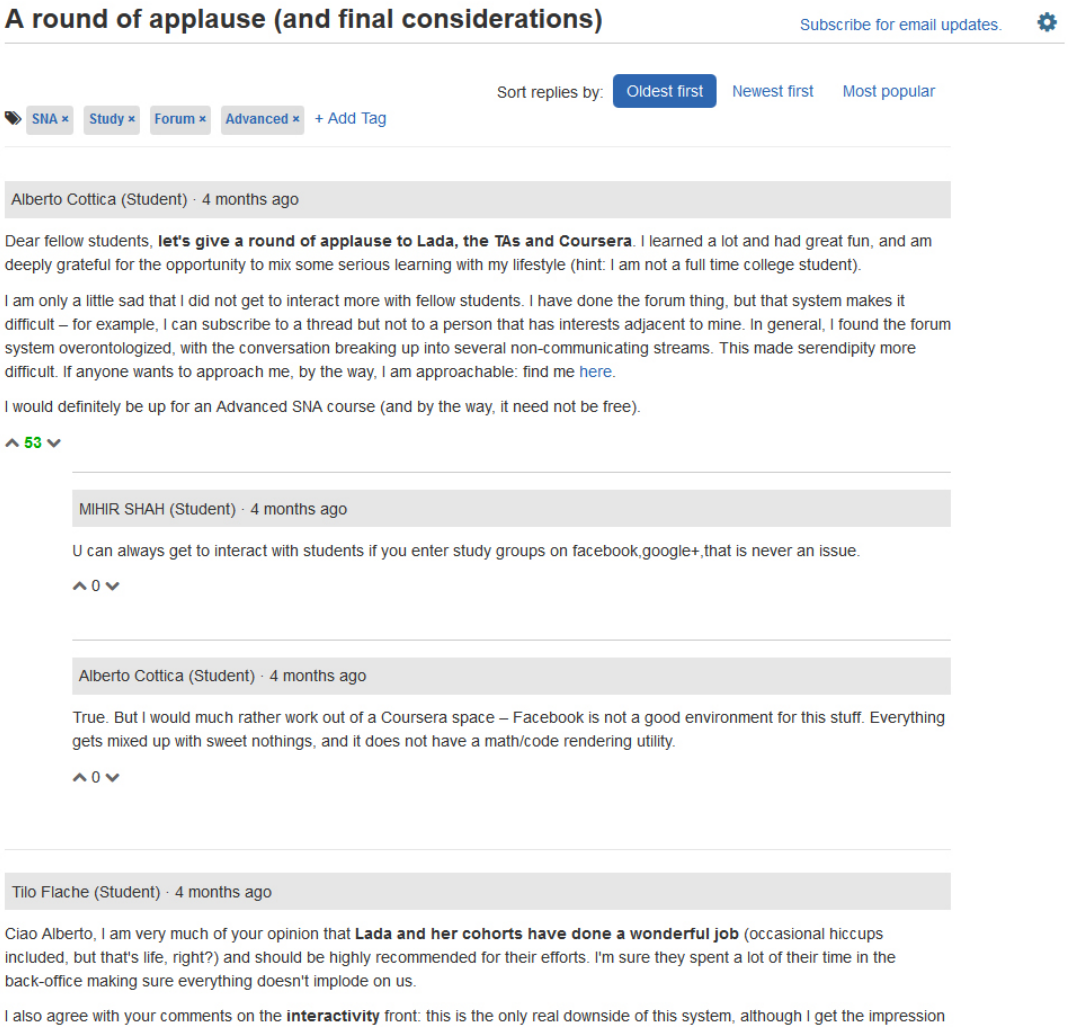

Figure 16. Structure of a thread/topic of a course in Coursera.

3.3.2 Udacity

In Udacity, it is possible to browse courses by categories[2] and levels (beginner, intermediate, advanced). In contrast to Coursera, courses are structured in a consistent way in Udacity divided into an "overview" providing information about the course instructors, learning objectives and a syllabus, the "classroom" consisting of video lectures with integrated quizzes, assignments, questions and notes, a "wiki" as well as a "forum".

[1] See http://twitter.github.com/bootstrap/ and https://dev.twitter.com/blog/bootstrap-twitter.

[2] Categories are Business, Computer Science, Mathematics and Physics (accessed 03/2013).

In Udacity, courses and lectures are more weakly bound to actual time-frames and deadlines. Students are preferably able to participate in courses regardless of time-frames. However, courses in Udacity are based on *progress*. Varying progress bars indicate the process of learning for the course in its entirety as well as for single lectures. The concept of visualizing progress in Udacity courses is shown in *Figure 17* and *Figure 18*.

Each lecture might be split into several *units* and *problem sets* whereas units are represented by videos[1] and problem sets are represented by short quizzes integrated into the lecture. Bigger and more individual types of problem sets are, in many cases, listed as independent lectures. Each unit or problem set is further linked to instructor notes and discussions of the course forum. This is working via tags with each unit respectively problem set having its own, unique tags that are available in the course forum. The structure of a lecture containing respective units, problem sets, discussions and instructor notes is illustrated in *Figure 18*.

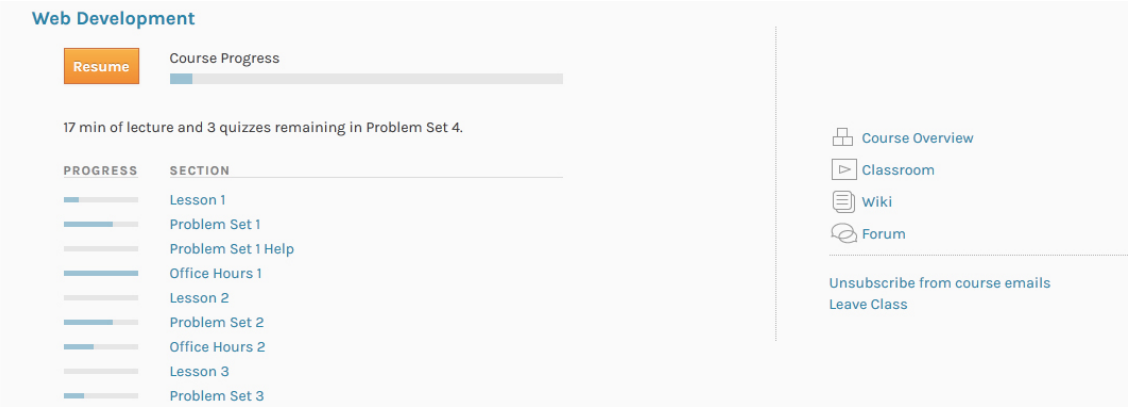

Figure 17. Visualization for course progress of a Udacity course.

Course forums in Udacity do not have any sub-forums. Actually, course forums even themselves are sub-forums of a general Udacity discussion forum[2]. Categorization and hierarchies in discussion forums in Udacity solely work via tags with each course having its own, unique tag. Furthermore there are some filters for re-arranging topics and their answers like “active”, “newest”, “hottest”, “most voted” or “unanswered” (this one particularly for topics). On top of each discussion forum there is space for displaying individual sets of tags of the respective course as a navigation menu. In the course forum

[1] In Udacity courses the author of this thesis has signed up for in the scope of this research, videos are consistently hosted by YouTube.

[2] See https://forums.udacity.com.

of the course “Web Development”, as shown in *Figure 19*, tags from each lecture and each (bigger) problem set are aggregated and displayed as a navigation menu divided into “unit tags” and “problem set tags”. In other courses, this space for a potential navigation menu might be blank.

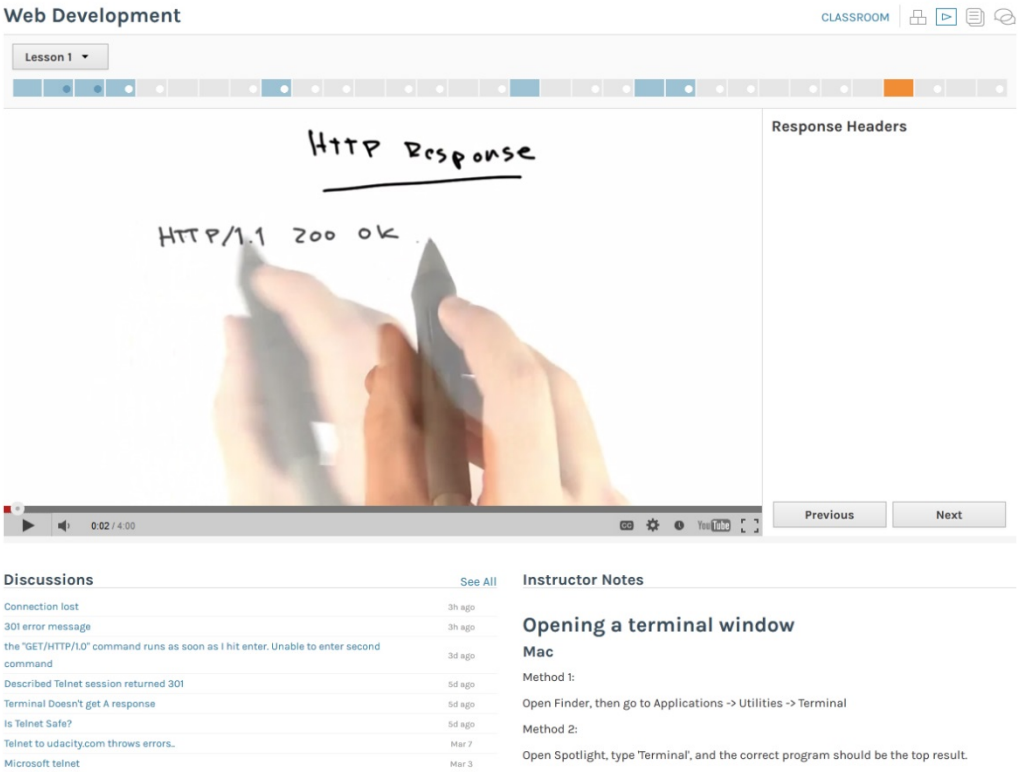

Figure 18. Structure of lectures in Udacity courses.

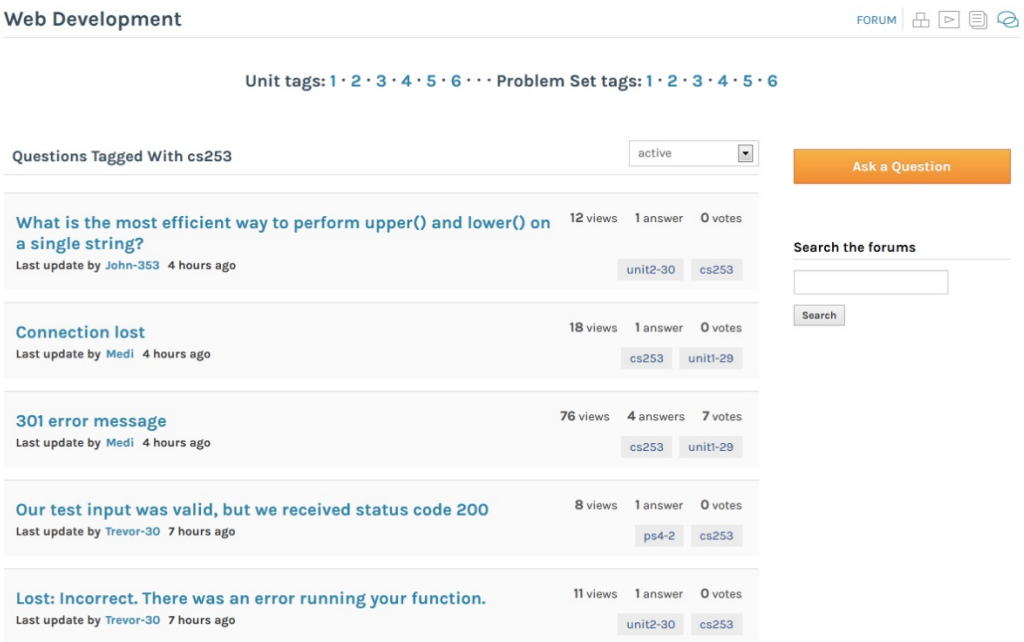

Figure 19. Structure of a course forum in Udacity.

As illustrated in *Figure 19*, topics are listed with their title, tags, user name and date of the last reply, number of views, number of answers and number of votes (again indicating the average value of the overall votes for this topic). Clicking on one of the unit or problem set tags in the navigation menu lists all tags for the respective lectures, i.e. their sub-units, with the number of topics for the particular sub-units, as shown in *Figure 20*.

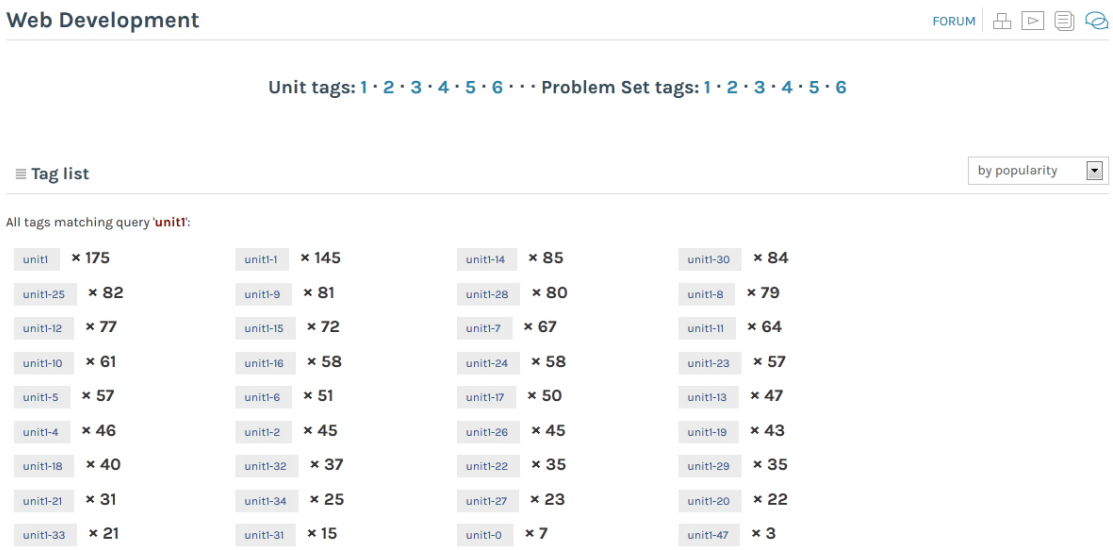

Figure 20. List of all tags for a lecture in a course forum in Udacity.

Similar to tags in Coursera, tags in Udacity can be chosen freely as the principle of folksonomy indicates. But, in contrast, only the author of a topic can choose the tags freely by default. Both adding tags to and removing them from topics afterwards by others is only provided for "experienced" users. The concept of "experienced" and "inexperienced" users is described later in this chapter. Also similar to Coursera, replies or comments within a topic in Udacity forums are displayed by two levels of hierarchy, i.e. replies to the thread resulting in comments that are displayed hierarchically on the same level as the starting post as well as replies to those very posts that are being displayed hierarchically one level deeper. Posts on the first level can be voted up (+1) and down (-1) with the average value of votes showing up. Posts on the second level, however, can only be voted up with no value of votes showing up. Furthermore, starting posts can be marked as "favorite" by clicking on the "star"-icon which is positioned beneath the interface for the votes. It is not entirely clear whether the "favorite" feature is for informational purposes only or also for retrieving or filtering topics. This obscurity also applies to the votes of posts on the second level as well as to some user information displayed within topics. For example the number of "badges" is being displayed beneath the user name in posts on the

second level and the "accept rate" (the percentage of user's questions with accepted answers) is being displayed beneath the number of badges in starting posts with no information about how to gain badges or how to accept answers (except for external FAQs concerning discussion forums in Udacity).

Specific features are just not displayed for "new" or "inexperienced" users that do not have enough reputation. Users can gain "karma points" when their questions or answers are up-voted. Features like retagging questions, down-voting, editing and deleting answers by others are only visible to users with sufficient reputation or "karma points"[1], respectively. However, new users only get informed about this concept when reading the FAQs concerning discussion forums in Udacity. These FAQs are not being displayed or linked prominently within the course forums. The author of this thesis reached the forum FAQs by trying to down-vote a post. In consequence, an error message popped up indicating that more reputation is needed for down-voting posts including a link to the FAQ site. Furthermore, it seems that different wording is used in the FAQs and the interface of the forum. The error message which has just been addressed references to "reputation" whereas the FAQs reference to "karma points". At that point, it remains unclear whether the previously addressed "badges" refer to "karma points" or to a separated concept as this concept is not mentioned in the FAQs. But, at any rate, it is described within the scope of forums in Udacity on a single page containing descriptions and number of awards for all available badges[2]. However, the author of this thesis could not find a link to this page within the forums in Udacity but has rather come across this page by searching for "udacity badges" via Google. According to the description of badges "you'll be recognised with badges to recognise actions that benefit the community". For example, a user will receive the badge "Famous Question" when asking a question which gets 10.000 views. Another example is the badge for "Nice Answer" which will be received when the user's answer has been up-voted ten times. The types of badges that users have been awarded with are displayed when clicking on user's public profiles. The concept of badges, therefore, serves for information purposes only and can be additionally regarded as a motivation for students to participate in the discussion forums.

[1] See https://www.udacity.com/faq.

[2] See http://forums.udacity.com/badges/.

The complete structure of a topic in course forums in Udacity including previously addressed concepts is displayed in *Figure 21*. As already mentioned, the "favorite" feature with the "star"-icon is only available for starting posts. Furthermore, it is recognizable that starting posts include the link to the respective video of a unit or problem set of a lecture if the appropriate tag has been set, though the link seems to be a little misplaced.

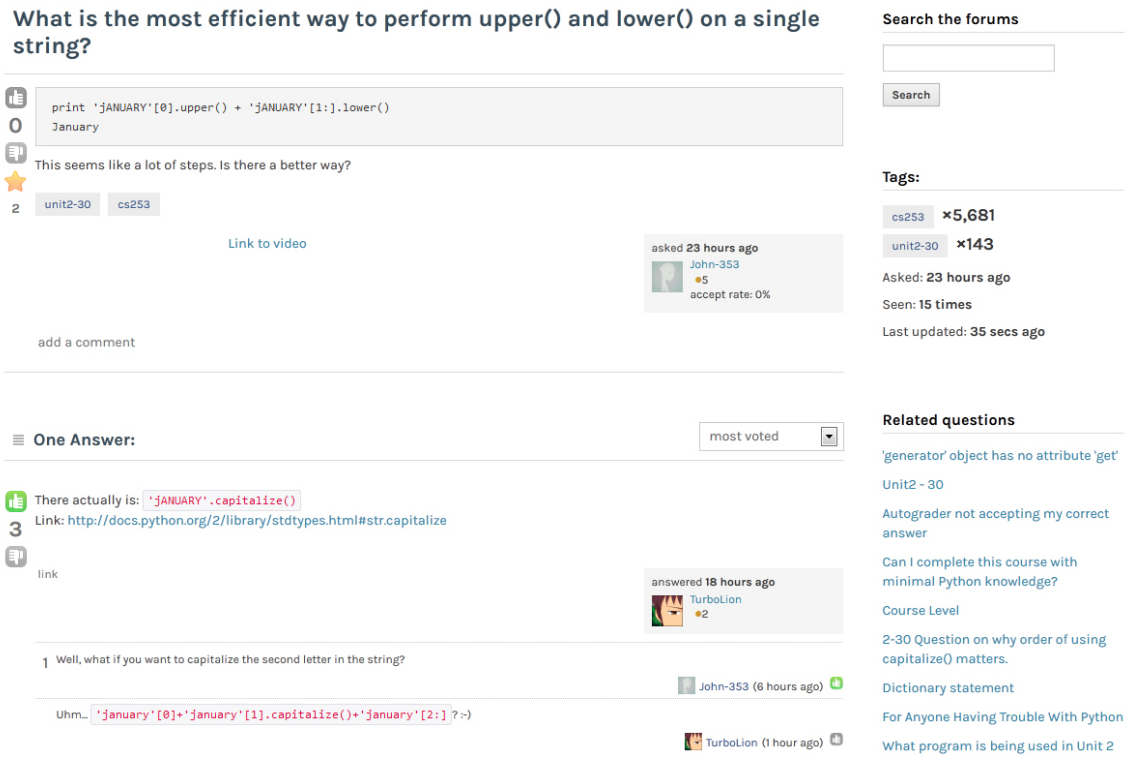

Figure 21. Structure of a topic in course forums in Udacity.

As regards content, discussion forums in Udacity are used for general and public kinds of communication, similar to discussion forums in Coursera. However, there are no sub-forums and no other channels for communication such as announcements, either. Topics strongly depend on tags as a concept of re-arranging and filtering content.

The most powerful use of this concept is, however, the linkage to lectures and unit and problem sets, respectively. While watching, listening to or accomplishing lectures and units the user is also automatically focused on appropriate questions in terms of content that others might have asked. Then again, the user is also provided with the possibility to ask questions on that specific lecture or unit without the necessity of additional browsing through the course forum and searching for the appropriate tag. Furthermore, the concept of lectures consisting of unit sets and problem sets can be used suitable where single lectures can not only serve as bigger problem sets but also as office hours (answers to

frequently asked questions on the course forum) or wrap-ups (conclusion and final office hour).

Concerning the concepts of usability, again similar to discussion forums in Coursera, Udacity's discussion forums can be regarded as commonly structured bulletin boards with the integration of some Web 2.0 concepts such as tags, votes and filters. The Web 2.0 character is strengthened through the use of AJAX whereas the content of information is extended through concepts like badges or favoring topics. Udacity's discussion forums are based on the open source Q&A system *OSQA*[1] which is developed by the makers of *AnswerHub*[2], an enterprise Q&A system. It has been adjusted and customized for the integration in Udacity and is further discussed within Chapter 4.4.

3.3.3 edX

In edX, courses are listed with their titles, starting dates and the university[3] which is providing the respective course. Courses in edX are structured individually but some navigation items seem to be available in every course. The starting page of each course usually consists of a blog / feed with course news and updates as well as course handouts and due dates, as shown in *Figure 22*. It is not provided to reply to course updates. Due dates regard homework, quizzes and problem sets. Besides the starting page which is referred to as "Course Info" or "Course Updates" other common navigation items include "Courseware", "Discussion", "Wiki" and "Progress". The wiki is similar to the wikis in Coursera and Udacity. The "Progress" site displays a graph as well as an overview of visualizing the percentage of points that have been reached for homework and assignments as well as the overall percentage of points that have been reached within the course.

[1] See http://www.osqa.net.

[2] See http://answerhub.com.

[3] During this research courses in edX have been provided exclusively by MITx, BerkeleyX and HarvardX (accessed 03/2013). Note that edX was found by Massachusetts Institute of Technology (MIT) and Harvard University.

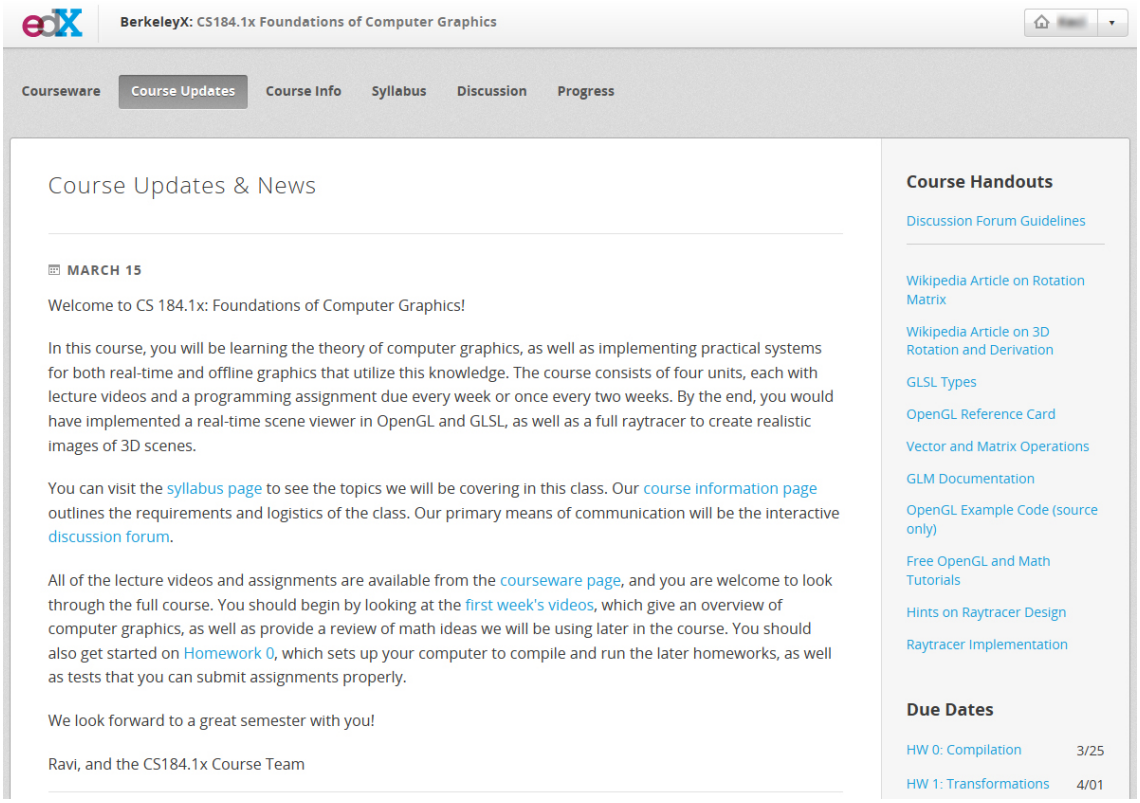

Figure 22. Starting page of a course in edX.

The "Courseware" site contains the actual lectures which are divided into lecture weeks, similar to Coursera. Lectures might include video streams[1] with a strong focus on synchronized sub-titles displayed on the right-hand side of video streams, with integrated quizzes and questions or discussions, similar to Coursera and Udacity. Lectures and quizzes are displayed on the top bar of a specific lecture with different types of icons. Discussions are displayed beneath respective video streams, problem sets or quizzes and are retrieved from the course forum. These topics are flagged with tags that indicate specific sections and contents of lectures. This is again similar to the concept of Udacity. The structure of the "Courseware" site is illustrated in *Figure 23*.

Discussions about lectures are faded out by default and get faded in by clicking on the "Show Discussion" button. However, there is no information as to whether discussions and comments actually exist for a specific lecture because there is no information about how many posts or topics exist for a specific lecture. Users have to click on the "Show Discussion" button to find out by themselves.

[1] In edX courses the author of this thesis has signed up for in the scope of this research, videos are consistently hosted by YouTube.

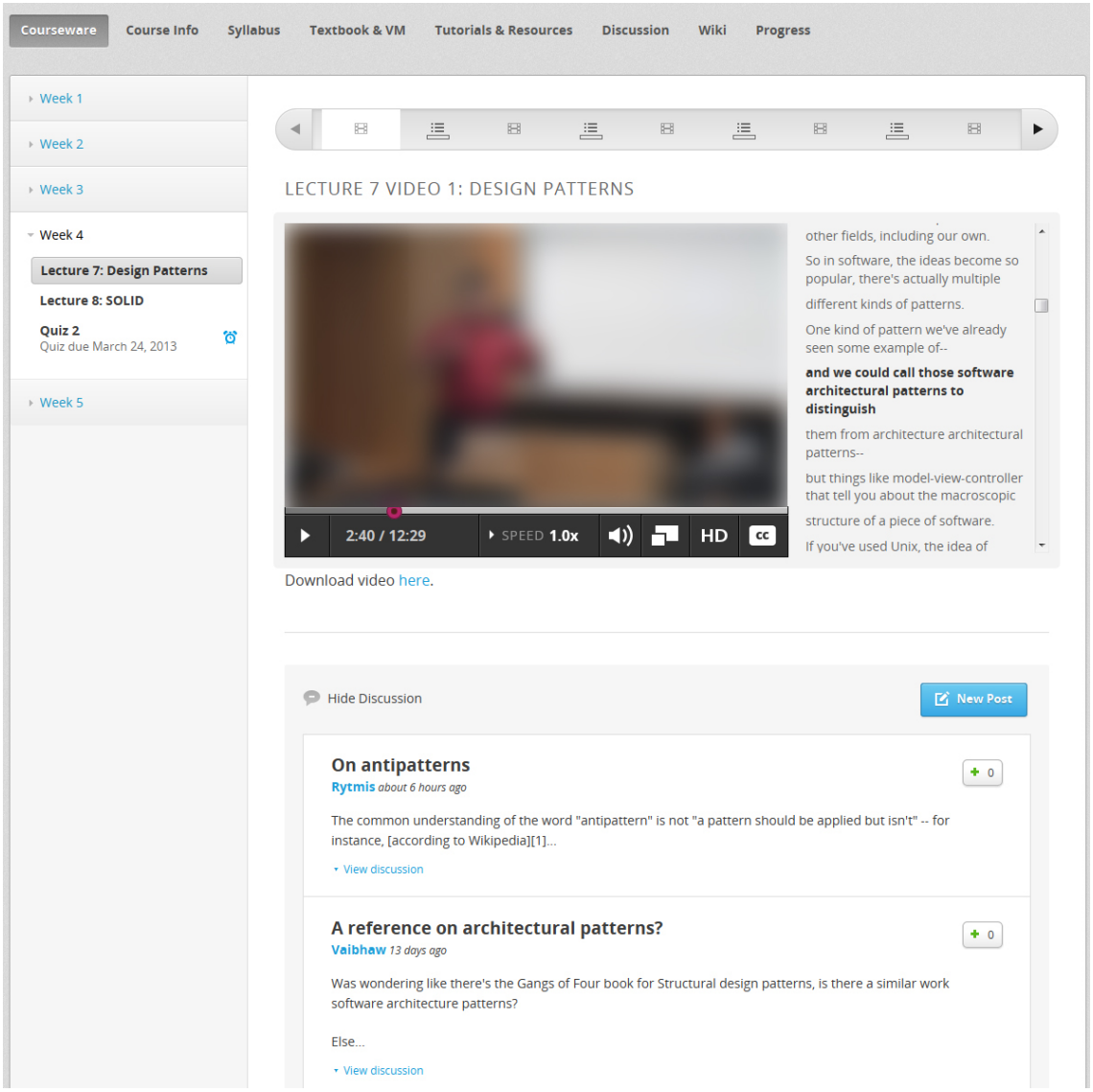

Figure 23. Structure for a lecture of a course in edX.

During this research, two separate discussion forums have been used in some of the lectures in edX the author of this thesis has signed up for. There is a discussion forum that is integrated into the edX system and especially into its courseware, as mentioned before, as well as an external discussion forum that is based on the *OSQA* system which is also used by Udacity and described in Chapter 3.3.2 and Chapter 4.4, respectively. During this research, the OSQA system has been used in addition to the default discussion forums in courses like “Software as a Service” provided by BerkeleyX. According to consent forms provided by such courses, the “experimental forum” based on OSQA is used for evaluating several features that the standard edX forum software does not provide, e.g. reputation scores for users associated with specific functions that are only available for users with a certain score of reputation. This concept has already been described in Chapter 3.3.2.

Users can either consent to participate in the study for evaluating the OSQA system and, therefore, use the "experimental forum" or use the edX standard forum. Anyhow, it should be noted that contents of the two separated forums are not identically or synchronized and that discussions displayed in the "Courseware" are derived only from the edX standard forum and not from the "experimental forum". Since the features and concepts of the OSQA system have already been described in Chapter 3.3.2, this chapter primarily investigates the features and concepts of the edX standard forum.

The structure of discussion forums in edX is similar to the structure of the Piazza system that has been described in Chapter 3.2. Topics are listed with their titles, number of votes and number of replies listed in a navigation bar on the left where also features for filtering, searching and sorting topics are available. The content of the topics and their replies are displayed on the right-hand side. Therefore, the user can be focused on the list of all available topics, not just a selection of related topics, with all its functionalities for filtering as well as on its contents at the same time. There is no need to switch between lists and content as is common in most discussion- and Q&A systems. The structure of discussion forums in edX is displayed in *Figure 24*.

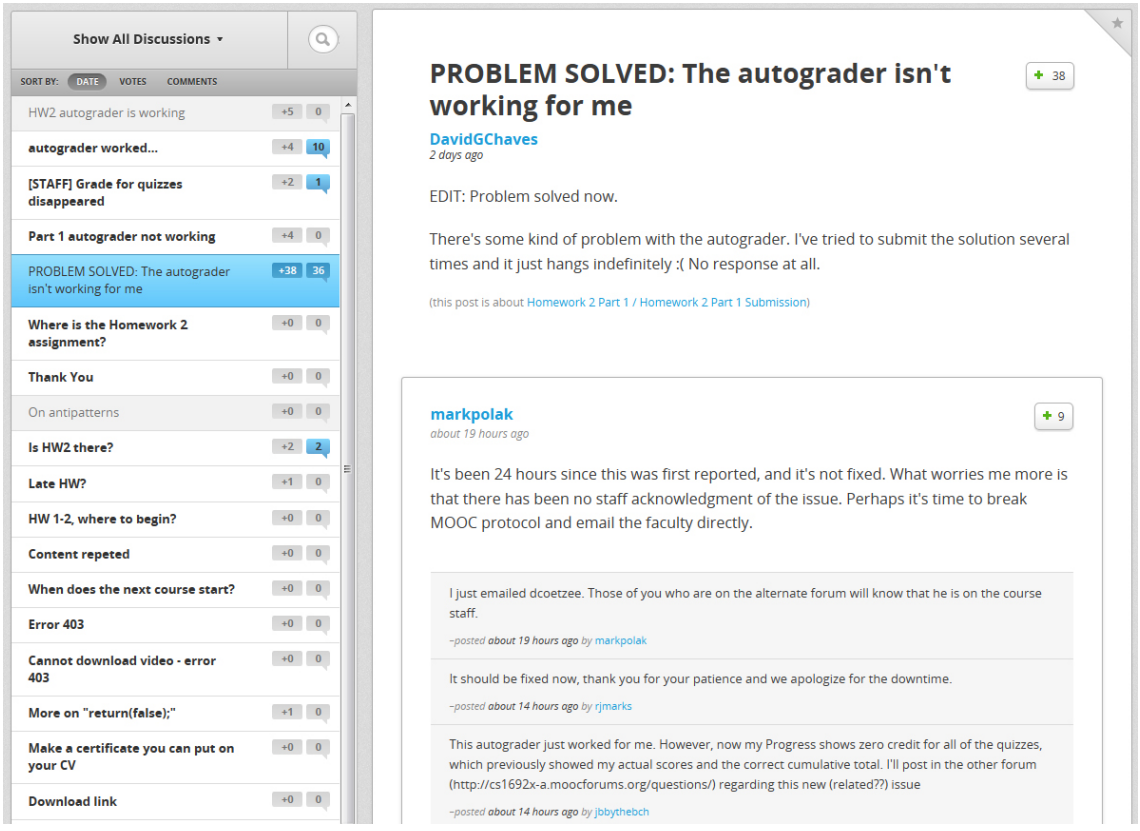

Figure 24. Structure of edX discussion forums.

Topics are sorted in order of dates by default and can be additionally sorted by the number of votes and the number of comments. Filtering is possible for a variety of tags whereas in this context tags can be rather regarded as categories. This is because on one hand these tags / categories are pre-defined and not available for multiple choice (only one tag can be assigned to a post) and on the other hand these tags / categories are not displayed as tags in a traditional way. Instead of the traditional visualization as a button, the respective tag / category is mentioned in textform beneath the text of the starting post. As seen in the example in *Figure 24*, the category is mentioned by the phrase "this post is about Homework 2 Part 1 / Homework 2 Part 1 Submission". The form of the tag / category of this example implies that there are sub-categories with "Homework 2 Part 1 Submission" being a sub-category of "Homework 2 Part 1", for example. So, also the structural concept of these categories is different to those of traditional tags. The interface for filtering categories and selecting categories for new posts is illustrated in *Figure 25*.

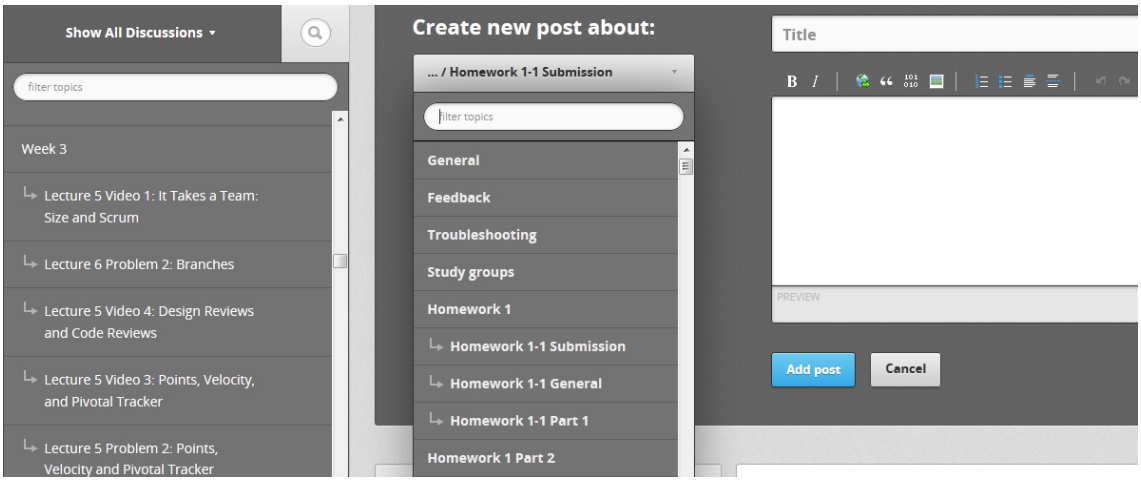

Figure 25. Interface for selecting tags / categories in edX discussion forums.

Similar to Coursera and Udacity, replies and comments within a topic in edX discussion forums are displayed by two levels of hierarchy, i.e. replies to the thread resulting in comments that are displayed hierarchically on the same level as the starting post as well as replies to those very posts that are displayed hierarchically one level deeper. Posts on the first level can be voted up (+1). Voting down (-1) is only available in the sense of revoking a vote, so a "real" down-vote is not possible. The value of votes showing up is, therefore, the total number of votes. Furthermore, starting posts can be "followed" by clicking on the "star"-icon which is positioned on the top-right-corner. These topics are then saved as a particular filter with the title "Following" (which of course is only available for filtering

posts but not for adding posts, i.e. it is not a real category). For posts on the second level, however, no type of interaction is provided. Regarding users, no information except the user name is provided. When clicking on a username, there is no such thing like a user profile. Merely, the discussions the respective user has been participating in are listed.

Concerning concepts of usability, edX proceeds rather new approaches with structures that are different to that of commonly structured bulletin boards. edX forums heavily rely on the previously mentioned categories. There is no such division into sub-forums like in Coursera or Udacity but the topics themselves are central. Categories play a minor part in the interface but a bigger part in functionality. The interface itself is simply structured with few features and possibilities for interaction, i.e. votes and filters, but with heavy use of AJAX and dynamic approaches for interface and interaction design strengthening the Web 2.0 character of the system.

4 CMC in Web 2.0 and Social Software

Chapter 3 revealed that communication trends in solutions used in Higher Education are towards using concepts known from Web 2.0 as regards usability, interface and interaction design. As a consequence, this chapter reflects on and evaluates concepts of contemporary and well-established Web 2.0 applications and social software. The reader should note that the following review does not regard all substantial aspects of such applications, websites or networks but focuses rather on the review of usability concepts and approaches for online communication considered relevant for the context of this research. Thus, the evaluation is especially focused on Social Networks, Social News Aggregators and Web-based Q&A systems since these fields of application all comprise different aspects that are also considered relevant to the context of online communication in Higher Education. Although Social News Aggregators and Web-based Q&A systems can be regarded as Social Networks, they will be covered separately within this chapter. Furthermore, an overview of studies regarding the integration of Social Networks, Social Software and Web 2.0 applications within the context of teaching, learning and Higher Education will be provided.

4.1 Principles of Web 2.0

Although the terms Web 2.0 and Social Software are often used synonymously, Social Software is actually just a subset of Web 2.0 (Schommers, 2009, p. 38). The term Social Software is widely defined as a software system that supports communication and cooperation between human beings (Bächle, 2006) and has already been used in the beginning of the 1990s. However, in reference to Web 2.0, the term has initially been used in 2002 within the context of new kinds of web applications like wikis and weblogs (Bächle, 2006; Schommers, 2009, p. 38). Nevertheless, both terms “apply to a set of characteristics in the context of the internet and applications served over it” (Phipps, 2007, p. 1). This is also coherent with the well-established and widely cited definition of Web 2.0 by Tim O’Reilly:

> "Web 2.0 is the network as platform, spanning all connected devices; Web 2.0 applications are those that make the most of the intrinsic advantages of that platform: delivering software as a continually-updated service that gets better the more people use it, consuming and remixing data from multiple sources, including individual users, while providing their own data and services in a form that allows remixing by others, creating network effects through an "architecture of participation," and going beyond the page metaphor of Web 1.0 to deliver rich user experiences."
>
> (O'Reilly, 2005)

Basically, with this definition, O'Reilly provides some analogies that are used for defining what Web 2.0 is. Later, he actually came up with a new attempt at a brief definition of Web 2.0:

> "Web 2.0 is the business revolution in the computer industry caused by the move to the internet as platform, and an attempt to understand the rules for success on that new platform. Chief among those rules is this: Build applications that harness network effects to get better the more people use them. (This is what I've elsewhere called "harnessing collective intelligence.")"
>
> (O'Reilly, 2006)

Both definitions imply a variety of different aspects and analogies in the context of Web 2.0 which are further described in the papers "What Is Web 2.0: Design Patterns and Business Models for the Next Generation of Software" (O'Reilly, 2007) and "Web 2.0 and social software: An introduction" (Phipps, 2007). The following list outlines these principles:

- *The Web as platform:* Applications and businesses are delivered via the web.
- *Harnessing collective intelligence:* Network effects from user contributions are the key to market dominance in the Web 2.0 era. Web 2.0 applications get better the more people use it and are designed to encourage and support users in contributing to them.

- *Data is the next Intel Inside:* Database management is a core competency of Web 2.0 companies with trends towards mash-ups of data and services through APIs[1] and open data projects such as Wikipedia, Creative Commons[2] or OpenStreetMap[3].

- *End of the software release cycle:* Web 2.0 applications are not delivered as a versioned product but as service that is in continuous development and improvement.

- *Lightweight programming models:* Web 2.0 heavily relies on lightweight web services such as RSS[4] or REST[5] which allow simple access to data. Furthermore, many web services using AJAX can be decrypted by hackers and web developers in order to remix data into new or other services. This concept is called "innovation in assembly" where new applications or services are created by simply assembling two or more other services or applications in effective ways.

- *Software above the level of a single device:* Software is no longer limited to the PC platform but available via a variety of devices.

- *Rich user experiences:* Web 2.0 applications are characterized by interfaces and user experiences that are as rich as in local PC-based applications. A key component of such "Rich Internet Applications" is the use of AJAX which has already been described briefly in Chapter 3.2.

The reader should note that these principles by O'Reilly were defined in 2007. Since then, Web 2.0 has experienced a huge evolution. Hence, some of these principles might, nowadays, be regarded as requirements for successful and vivid websites (e.g. *rich user experiences* or *software above the level of a single device*). Yet, these principles still

[1] Application Programming Interface.

[2] See http://www.creativecommons.org

[3] See http://www.openstreetmap.org

[4] Rich Site Summary and/or Really Simple Syndication

[5] Representational State Transfer

characterize Web 2.0 and its key concepts and do also apply largely to the MOOC providers described in Chapter 3.3, for example.

Thus, the MOOC providers use the web as a platform to proceed their business and provide their services. Their software is undergoing a continuous change and further development whereas the application is getting better the more people are using it and contributing knowledge and information to it. Therefore, a lot of social features and interaction possibilities are integrated. Furthermore, the previously mentioned MOOC providers attempt at providing rich user experiences and valuable contents by using technologies such as AJAX and mixing up different types of content such as videos, audios, downloads, wikis and discussion forums.

4.2 Social Networks

When investigating Social Networks, one should note that Social Networks are regarded as common and trivial parts of daily life by the majority of society, especially in Western countries. According to a report published by the Pew Research Center, 65% of online adults use social networking sites with only email and search engines being used more frequently (Madden & Zickuhr, 2011, pp. 1-2). In addition to that, a recent report by Nielsen Holdings N.V. states that 20% of time spent on PCs and 30% of time spent on mobile devices is being spent on Social Networks (Nielsen Holdings N.V., 2012, p. 4).

> "For millions of Americans today, social networking has become a part of their daily routines. They come home from school or work, turn on their computers, and log onto Facebook, MySpace, or Twitter. From the comfort of home, people can communicate with hundreds of friends at once by posting a status update or a "tweet" on Twitter."
>
> (Lusted, 2011, pp. 6-7)

Regarding these effects of Social Networks, it is safe to assume that people are also used to concepts of well-established Social Networks in concerns of usability, interface and interaction. Such concepts are also considered relevant to other fields of application in order to provide comfortable, usable and self-explanatory systems and solutions. Especially for the field of Higher Education, where, according to a report by the Pew Research Center, 72% of all college students use Social Networks with 45% of college

students using Social Networks at least once a day (Lenhart et. al, 2010), further investigation into concepts of Social Networks is inevitable. Before referring to concepts of Social Networks regarding usability, interface and interaction design, the following definition by Boyd & Ellison (2007) is to provide a brief overview of what a Social Network explicitly means.

> "We define social network sites as web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system. The nature and nomenclature of these connections may vary from site to site."
>
> (Boyd & Ellison, 2007)

With people and social interaction as a central character in Social Networks, a variety of concepts and principles regarding usability, interface and interaction design have been established that are addressed in informative articles by Ho (2009) and Cronin (2009). A selection of these concepts that might also fit in with the context of online communication in Higher Education is outlined and summarized in the following list:

- *Simple and user-centric interfaces:* Social Networks are characterized by simplicity in user interfaces with the color scheme usually consisting of only a few colors, white or light backgrounds, a few highlighted elements, many icons and approaches that are not trying to be too unique and original but rather stick with common conventions for e.g. placing or labeling specific elements (e.g. a search bar with a search icon on the top-right corner of the page). Interface options are designed, placed and presented in an intuitive, context-sensitive way that is also extremely user-centric for the purpose of presenting contents that are relevant to a specific user. Every type of content, especially text, is treated as user interface in order to provide clear visual and structural hierarchy on the website with a calm separation of elements as a prerequisite for making content readable, scannable and easy to perceive. Furthermore, only relevant information is being displayed. The user should not be overwhelmed with information unless interested in it.

- *Prominent and functional search:* One of the most important functionalities in Social Networks is the search which is often provided in form of a live search, filtering or search for specific types of content and connections in the social graph (e.g. groups, communities, interests, photos, etc.).

- *Effective use of buttons and text links:* Buttons and text links are naturally perceived in different ways where text links are used for navigation and buttons are used for actions. Thus, especially with a variety of different actions available important actions have to be emphasized.

- *Visual feedback on performed actions:* Visual feedback is important to let the user know that something has been done or is in the process of being done. It can be provided in the form of loading icons, process indicators or hover and click effects such as effects on button interactions that actually make buttons not only look like buttons but also feel like buttons.

- *Simple and usable forms:* Forms are extremely important and thus need to be usable, simple and self-explanatory. The easiest way of keeping forms usable is keeping them as short as possible. Furthermore, labels and input fields need to be situated in a way that takes as less cognitive power as possible to process the association between the two (label and input field).

- *Real-time updates:* Social Network users want to observe what happens *right now* in real-time. This concerns messages, posts, replies or new status updates and can happen for example via fading in alerts, pop-ups, content re-rendering or information bars indicating a page reload or refresh in order to see activities that are new since the user's last action or activity, respectively.

With this list describing roughly how usability and interface principles in successful Social Networks are conceptualized, a further research into the concepts of two of the most popular Social Networks, *Facebook* and *Twitter*, is considered relevant.

4.2.1 Facebook

The following review of Facebook focuses on its omnipresent *News Feed*[1] that provides the possibility to communicate about different types of content by using the same, transparent and *unified* concept. The News Feed is represented by the center column of Facebook's home page and displays a list of stories which is being constantly updated, including status updates, photos, videos, links, app activities and likes from people and Pages that a user follows. Although the representation of feeds for the previously mentioned types of content differs minimally, users are able to comment, like or share different types of content the same way. The looks and concepts of Facebook's News Feed have been changed frequently through the years since its first introduction in September 2006 (Sangvi, 2006) and still are in continuous change and further improvement. Thus, Facebook perfectly fits in with the context of a Web 2.0 application in the sense of the definition provided in Chapter 4.1. A recap on Facebook's News Feed changes since 2006 is provided by an article by The Huffington Post (Kanalley, 2013).

Posts in Facebook's News Feed include the profile pictures and names of people and Pages, respectively, the proper content (e.g. textual status updates, links, activities, etc.), the relative time (in the sense of providing real-time updates) as well as number, content and interface options for likes, comments and sharing. Within this thesis the functional principles of likes, comments and sharing will not be further elaborated as they can be looked up in Facebook's Help Center[2].

The structure of posts in Facebook's News Feed is illustrated in *Figure 26*. Here, the first two posts are originated by Pages whereas the third post is originated by a person/friend and indicates a place activity (person *was at* place). As these posts (the first two posts are from Pages, the last post is from a person) show the text box for writing a comment is only faded in per default for posts from people, not for posts from Pages. Comments would also have been faded in per default for posts from people and the indicator for the number of likes is displayed differently for people and Pages.

---

[1] See https://www.facebook.com/help/327131014036297/.

[2] See https://www.facebook.com/help/452446998120360/ for "Like", https://www.facebook.com/help/333140160100643/ for "How to Post & Share" and https://www.facebook.com/help/499181503442334/ for "Commenting".

Figure 26. Structure of posts in Facebook's News Feed.

However, such slight differences do not only appear for different types of authors of posts but also for different types of content of posts. For example, for shared photos, comments and the text box for writing a comment are faded out in most cases. Otherwise, the behavior for showing or hiding comments or specific elements for posts also depends on factors such as the number of likes and comments or the connection between the user and the initiator of a post in the social graph. The author of this thesis, however, in the scope of this research could not find out about how the algorithm of showing and hiding specific elements particularly works in Facebook. Furthermore, there are different priorities for sorting posts in the News Feed in order to display "important" posts prominently (e.g. on top) and to determine whether a post by a Facebook Page shows up at all. The sorting algorithm of Facebook's News Feed is commonly referred to as EdgeRank[1], which is similar to Google's PageRank[2] (Constine, 2012).

The four main factors for determining if a post by a Page shows up in the News Feed are outlined by an article by TechCrunch (Constine, 2012) and are described below:

- The more the user interacts with posts by a Page, the more from that Page will be shown up.

[1] See http://www.whatisedgerank.com.

[2] See http://en.wikipedia.org/wiki/PageRank.

- The more other people react to posts by a Page in a positive way, the more likely these posts will be shown up. The more other people complain or ignore posts by a Page, the less likely these posts will be shown up.

- The more the user interacts with posts of the same type of content (e.g. photos), the more posts of that specific type will be shown up.

- The more complaints the Page received in the past, the less likely posts from that Page will be shown up.

Reflecting on usability and interaction concepts reviewed in the context of MOOCs in Chapter 3.3, it is noticeable that in Facebook there is no such thing as voting. The comparable concept is the well-known and popular "Like". Facebook describes the "Like" in its Help Center as follows:

> "Clicking Like under something you or a friend posts on Facebook is an easy way to let someone know that you enjoy it, without leaving a comment. Just like a comment though, the fact that you liked it is noted beneath the item."
>
> (Facebook, 2013)

Regarding comments, for posts with a great number of comments only a subset of comments is displayed per default. Other comments can be loaded and faded in on demand. In most cases the most recent comments are displayed. Until March 2013 commenting was only available on one level of hierarchy, i.e. commenting the actual post. On March 25, 2013, however, Facebook introduced its new concept of conversations on Pages with the ability to reply to comments (Lavrusik, 2013), i.e. since then it is possible to comment on two levels of hierarchy as it is also common in the systems of the MOOC providers described in Chapter 3.3.

> "You and your readers will have the ability to reply directly to comments left on your Page content and start conversation threads, which will make it easier for you to interact directly with individual readers and keep relevant conversations connected. Also, the most active and engaging

> conversations among your readers will be surfaced at the top of your posts ensuring that people who visit your Page will see the best conversations."
>
> (Lavrusik, 2013)

This is a big change on Facebook's conversation concepts in order to provide the possibility for improving sourcing questions, topical conversations and open Q&A's (Lavrusik, 2013). *Figure 27* illustrates the structure for Facebook posts that provide the ability to reply to comments (Facebook Pages are able to decline this ability). Depending on the number of replies and on who replied on comments, the number of replies, the person or Page who replied and/or the text box for writing a new reply might be displayed.

Figure 27. Structure for Facebook posts with the possibility to reply to comments.

As these examples show it is essential for Facebook to particularly define which elements and contents are faded in or faded out per default in order to not overwhelm the user with content. Furthermore, it seems very important that there are not too many interface options shown up (likes, comments and sharing is in focus) and that the user has the possibility to load specific elements or contents on demand. This all happens via AJAX, as expected.

4.2.2 Twitter

Twitter is actually defined as a Microblogging[1] service. However, although its character is controversial and frequently discussed, for example in the paper "What is Twitter, a Social Network or a News Media?" (Kwak et. al, 2010), Twitter can be regarded as an exemplary Social Network in concerns of simplicity for interfaces and the sense of "less is more" (Myers, 2011). The CSS framework used and developed by Twitter is called *Bootstrap* and is available for free. Bootstrap is described on its official repository as a "sleek, intuitive, and powerful front-end framework for faster and easier web development"[2]. It is the most popular repository on the web-based hosting service GitHub[3] (GitHub, 2013).

Regarding *Tweets* in Twitter, less elements and interface options as possible are displayed per default. Tweets are displayed with profile picture, username and nickname of the user as well as with the text of the tweet and the relative time (in the sense of providing real-time updates). Links to external web pages, mentions of other users (represented as @username) as well as the popular hashtags[4] (represented as #hashtag) within the text are highlighted as hyperlinks. Further context-sensitive information and interface options such as links labeled as "View media" for videos, "View photo" for photos, "View summary" for articles or "View conversation" for conversations are also included. The interface options for actions, however, are only displayed by hovering over a tweet. The principle for fading in interface options by mouseover/hover is also used in many other Social Networks and web applications in general. The available actions regarding a Tweet in Twitter in particular are "Reply", "Retweet", "Favorite" and "More" (including the actions

[1] See http://en.wikipedia.org/wiki/Microblogging.

[2] See http://twitter.github.com/bootstrap.

[3] See https://github.com.

[4] See https://support.twitter.com/entries/49309-what-are-hashtags-symbols.

"Email Tweet" and "Embed Tweet"). The structure of Tweets in Twitter is shown in *Figure 28* with the Tweet displayed on top showing the available interface options / actions that get faded in on mouseover/hover. All three Tweets include links to external articles and, therefore, the "View summary" link is displayed. Above the tweets a bar indicates the number of new Tweets since the last page reload or refresh of Tweets, respectively. By clicking on this bar, new Tweets are loaded and faded in on demand. This as well as other interaction such as posting new tweets, replying or retweeting happens via AJAX.

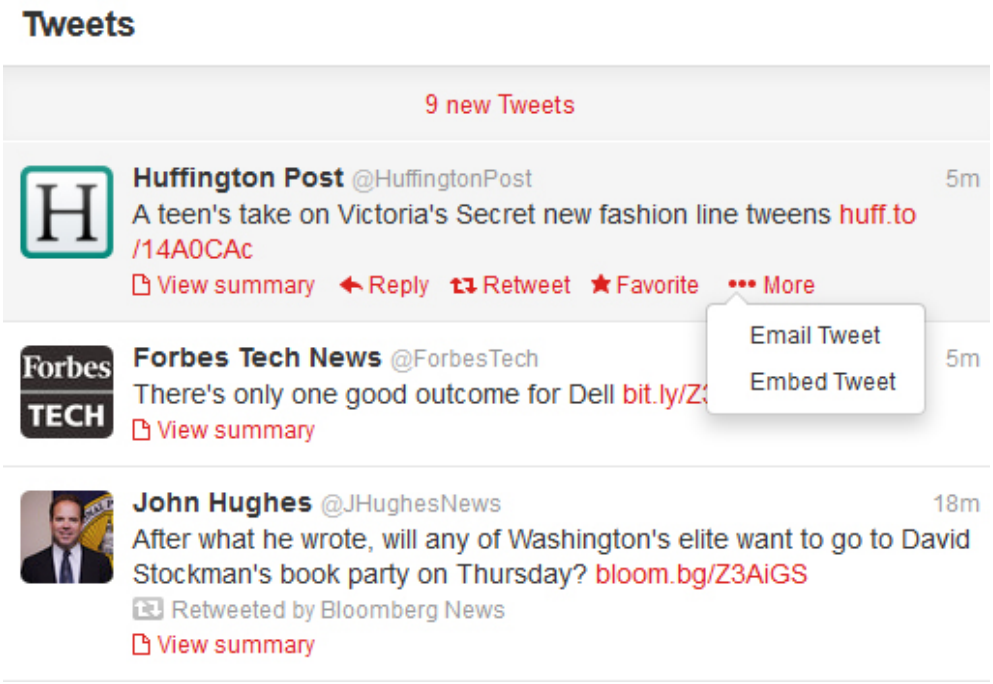

Figure 28. Structure of Tweets in Twitter with available interface options / actions displayed at the Tweet on top on mouseover/hover.

In comparison to features like voting, following and favoring used in the systems by the MOOC providers described in Chapter 3.3 or the likes in Facebook, Twitter has the "Retweet"- and "Favorite"-features. Retweets[1] can be regarded as a mixture of liking/voting and sharing. Although a retweet is a re-posting of someone else's Tweet, i.e. sharing someone else's content, it is also frequently used as a form to show that someone "likes" someone else's content whereas actually the "Favorite"-feature[2] has been designed for that purpose.

[1] See https://support.twitter.com/articles/77606-faqs-about-retweets.

[2] See https://support.twitter.com/articles/14214-what-are-favorites.

The previously mentioned hashtags are regarded as a basis of Twitter's functional principle and success. They are used as sort of meta-commentary (Parker, 2011). Tweets can be freely flagged with hashtags. In consequence all tweets linked to specific hashtags can be retrieved which corresponds to the principle of folksonomy, as already addressed in Chapter 3.2. The popularity of hashtags has been growing as they are used especially for live-tweeting events or promotion. Hashtags "have transcended the 140-characters-or-less microblogging platform, and have become a new cultural shorthand, finding their way into chat windows, e-mail and face-to-face conversations" (Parker, 2011). According to several reports, at the time of research of this thesis, even Facebook is working on incorporating the hashtag to group conversations (Tate, 2013).

4.3 Social News Aggregators

A Social News Aggregator, frequently also referred to as Social News website or Social Network Aggregator, is a type of social media that links to newsworthy online articles but rarely offers original content itself (Virasoro et. al, 2011, p. 1).

> "Within a social media aggregator such as Digg.com, registered users are able to participate by submitting, commenting and voting on content they like or dislike. Users can send in news or blog articles, images and videos by submitting a link to the web page where the information can be found, together with a title and brief description of the media item."
>
> (Doerr et. al, 2012, p. 3)

Within this chapter, two popular Social News Aggregators, *Digg* and *Reddit*, will be roughly reviewed and evaluated in concerns of concepts of usability, interface and interaction design. Certain aspects of these platforms will consciously be omitted within this review as they do not fit in with the scope of this research. As the above definition indicates, the social graph might be considered less important in Social News Aggregators than in traditional Social Networks. The focus is rather on the actual content, i.e. news and articles that have been shared on such a site.

4.3.1 Digg

Digg was one of the first social media sites introducing social components like having friends and followers (Walker & Ante, 2012). However, the site re-launch by Digg with *Digg v1* in August, 2012 confirms the above stated assumption that the social graph can be neglected in contrast to actual contents in Social News Aggregators. With the re-launch, Digg changed from a layout structure consisting of rows of headlines next to tiny images to a design that is based on relatively large pictures (Bosker, 2012). Accompanied by this re-launch, Digg has abandoned its earlier existing user accounts and only provides login via Facebook and Twitter accounts from that moment on. As a consequence, the re-launch of Digg v1 received lots of critically and mixed reviews (Johnson, 2012; Vernon, 2012). Digg v1 focuses on the integration of Facebook and Twitter in order to improve its "Digg Score" algorithm whereas a "digg" is considered as a positive vote that includes the sum of diggs ("thumbs-ups"), Facebook shares and tweets for a story (Digg, 2013). This concept is comparable to the voting systems of the MOOC providers described in Chapter 3.3 or the "likes" in Facebook. The main difference is that the "digg" vote is aggregated by votes from different sources or different networks, respectively. The basic idea of the "Digg Score" is to effectively figure out which stories are "hot" in order to present such stories prominently. However, submitted stories additionally get moderated by Digg moderators to provide better ranking and to avoid spam (Digg, 2013).

Other available interface options besides the option for "diggs" are saving and sharing. Digg stories can be shared to Facebook or Twitter. Saved stories can be read later and are listed within the navigation tab menu with the label "Saved". The layout of Digg's starting page is illustrated in *Figure 29*. The navigation menus, "Top Stories", "Popular" and "Upcoming", actually do not refer to other pages as they are linking to different sections of Digg's starting page. These sections all include Digg stories but are visualized and structured differently. The section "Top Stories" is displayed in *Figure 29* and contains stories with titles, sub-titles, tags, a description and the interface options for "Digg", "Save" and "Share". The button for "Digg" is faded in per default, the buttons for "Save" and "Share" get faded in on hover/mouseover, similar to the interface principles used by Twitter that are described in Chapter 4.2.2. In the example of *Figure 29* the story placed on top indicates a hover/mouseover. Here, all available interface options get faded in and are highlighted blue.

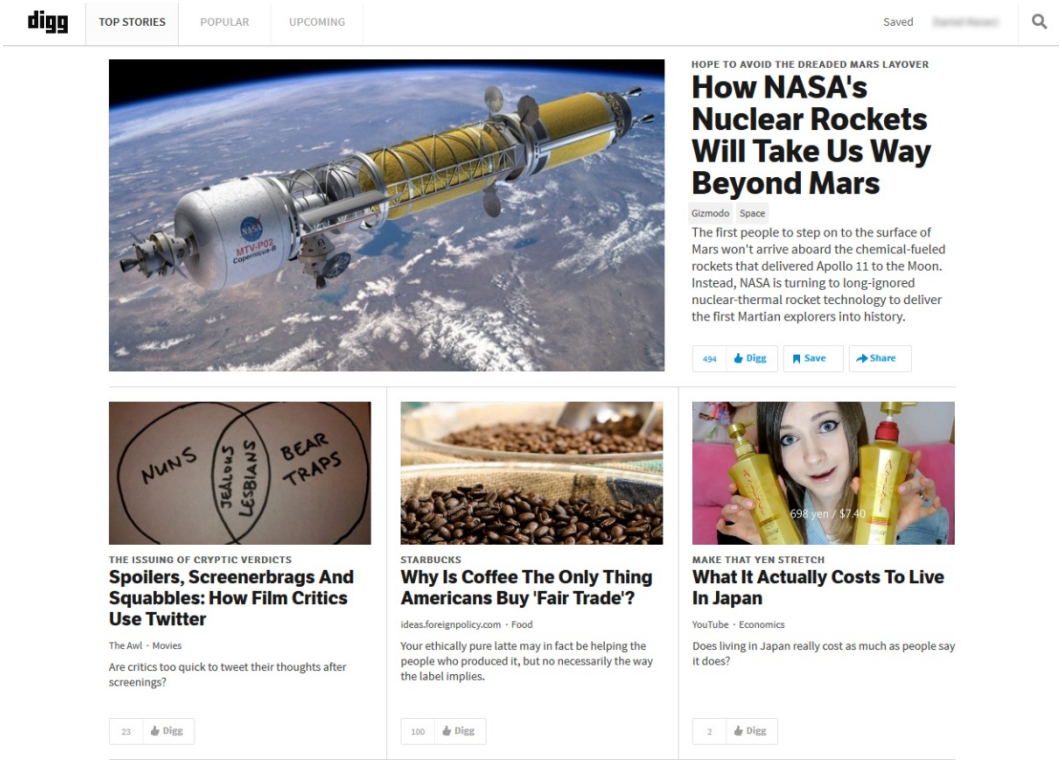

Figure 29. Structure and layout of Digg's starting page and its stories.

The section "Popular", in contrast, refers to frequently shared stories and is illustrated in *Figure 30*. Descriptions for stories are not included in this section but further information about the shared story is displayed, e.g. the content of tweets that reference to a story and the people who shared a story on Twitter. Interface options are displayed identically to stories within the "Top Stories" section with the first story in *Figure 30* indicating the hover/mouseover effect.

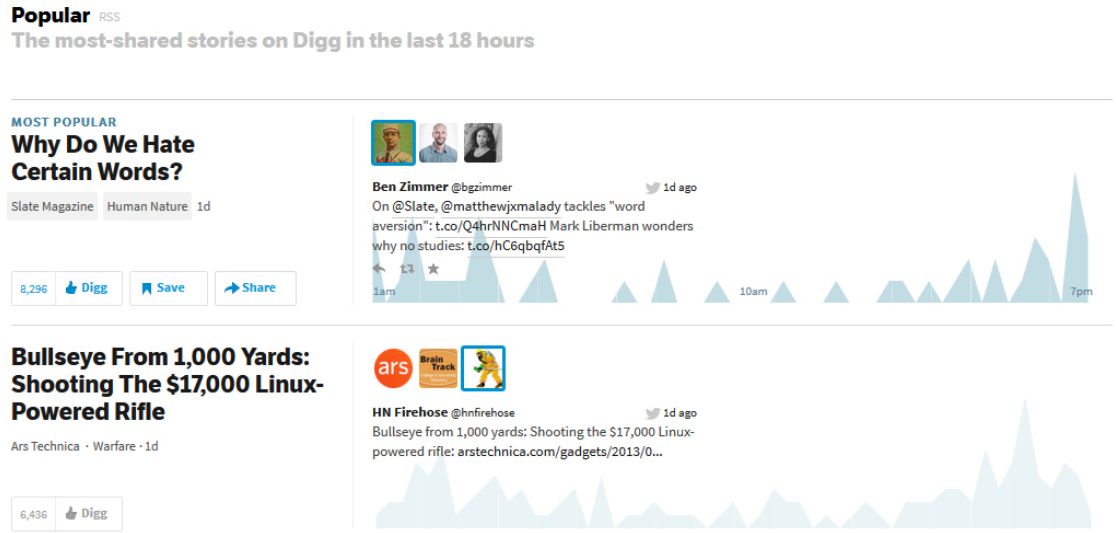

Figure 30. Structure and layout for popular stories in Digg.

The section “Upcoming” includes the newest stories on Digg and is illustrated in *Figure 31*. Here, stories are only displayed with their titles, the site that originated the story and the “Digg Score”. The actual “Digg Button” gets faded in only on hover/mouseover just as the buttons for “Save” and “Share”. In this layout, however, these buttons do not appear with their labels but only with their icons. The hover/mouseover effect is displayed within the second story in *Figure 31*.

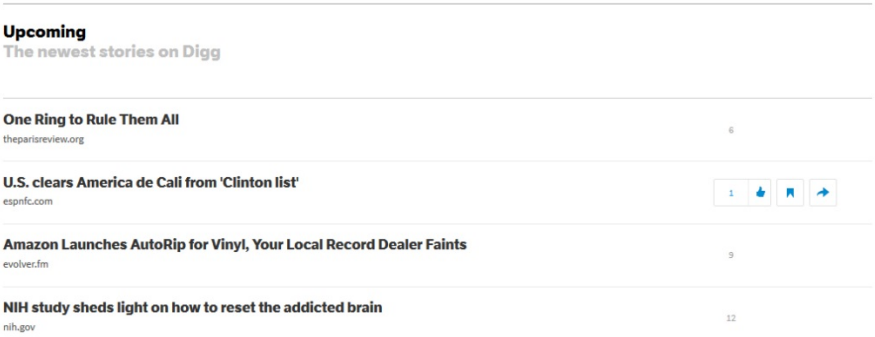

Figure 31. Structure and layout for upcoming stories in Digg.

During this research, Digg has not been implemented a feature to comment on stories. Digg’s FAQs (Digg, 2013), however, state that Digg is taking time on the comments feature and that Digg “will conduct a few experiments in commenting that will inform more permanent features”.

4.3.2 Reddit

In contrast to Digg’s concepts and principles concerning usability, interface and interaction design, its main competitor Reddit has not been focusing on redesigns or conceptual changes but rather on creating valuable communities for their users to enjoy (Tassi, 2012). Although content is clearly superficial in Reddit, the Social Network profits by its huge and active community.

> “What’s different about Reddit is that it’s a real, vibrant community, one of the few big websites where the users have constructed an unmistakable moral and political philosophy. Redditors are lefties who have a soft spot for Ron Paul, they’re taken with atheism and the legalization of marijuana, they hate political interference with the Internet, they love Stephen Colbert, and they’re gaga for animated GIFs.”
>
> (Manjoo, 2012)

Reddit was founded in 2005 and "is known as the front page of the Internet" with "over 1.6 billion page views each month" considered "one of the largest websites in the world with one of the most loyal communities online today" (Macale, 2011). As indicated above, Reddit is based on a very simple layout and site structure that is nothing like contemporary Web 2.0 approaches. AJAX is rarely used and the site is divided into a header and a content area. The header consists of the Reddit logo, categories (called sub-reddits), user preferences and a navigation menu with different filters and ranking options. The content area basically just lists stories on white site background without any structuring purposes. However, regarding the principle of calm separation of elements, as described in Chapter 4.2, stories on Reddit are visually separated by their relatively large titles that are highlighted blue. The layout of Reddit's starting page is illustrated in *Figure 32*.

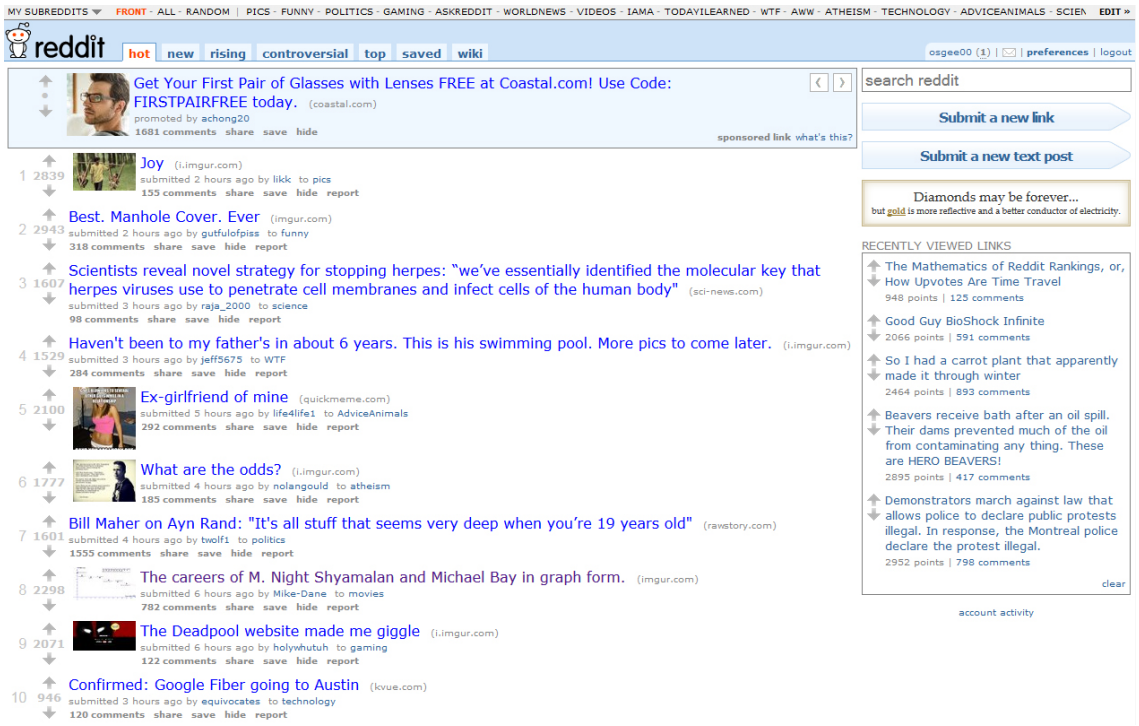

Figure 32. Structure and layout of Reddit's starting page and its stories.

The previously mentioned "sub-reddits" displayed at the top of the page refer to a concept similar to tags that differentiates stories as regards content. Each story is associated with only one tag, so sub-reddits serve for categorization and not for traditional tagging. Users can subscribe to and unsubscribe from sub-reddits, i.e. users have the opportunity to customize supplied content to their personal needs and interests. Filters and ranking options are visualized more prominently than sub-reddits and are displayed by navigation

tabs as shown in *Figure 32*. They are available within each sub-reddit. The filters and ranking options are "hot" (the default ranking based on the Reddit ranking algorithm described later within this chapter), "new" (ranking by newest submission date of stories), "rising" (ranking by new stories that are gaining attraction), "controversial" (ranking by stories that are receiving nearly as many up-votes as down-votes), "top" (ranking by stories with highest voting rank), "saved" (filtering by stories that have been bookmarked by the user) and "hidden" (filtering by stories that have been hidden by the user; this filter is not displayed in *Figure 32*). The tab "wiki" does not refer to stories but on a wiki including FAQs and other helpful information. As shown in *Figure 32* stories are displayed with their title, the website that originates the story, the submission date, the user name of the submitter, the respective sub-reddit of the story, the number of comments, the interface options "share", "save", "hide" and "report" as well as the number of votes or the "Reddit score", respectively.

Regarding votes and the ranking algorithm for stories in Reddit, it is possible to up-vote (+1) and down-vote (-1) stories but, however, the ranking algorithm does not only depend on the average value of votes. Salihefendic (2010) describes in a blog post how Reddit's ranking algorithm works. According to Salihefendic, in addition to the value of votes ranking heavily depends on submission time. Newer stories might rank higher than older stories as they get a higher score than older stories, i.e. for stories with the same amount of up- and down-votes the latest stories will get the highest rank. Apart from that, votes for stories are not valued equally. A logarithm scale is used that weighs the first 10 up-votes equally to the next 100 up-votes. These 100 up-votes, then, have the same weight as the next 1000 up-votes, and so on.

Similar to the ranking options for stories there are also ranking options available for comments within stories. Comments or replies, respectively, are displayed with their textual content, the user name of the submitter, the date of submission and the interface options "permalink" (generates a hyperlink to a specific comment), "report", "give gold" (a form of "liking" or "saying thanks") and "reply". It is possible to reply to any other comment in Reddit, i.e. the concept of infinite threading is used. These comments are displayed within a tree-like structure and can be faded in and out. This is different to the discussion forums of the MOOC providers described in Chapter 3.3 or the Social Networks described in Chapter 4.2 where commenting is only possible on two levels of hierarchy.

However, infinite threading for comments that are displayed within a tree-like structure is rarely used in contemporary Web 2.0 applications. There are rather new approaches to threaded and nested discussions as described and evaluated by Holzkorn (2011). Furthermore, it is possible to vote for comments, again by up-voting (+1) and down-voting (-1). The average value of votes for comments is not displayed between the interface elements for up- and down-voting as it is in stories, but in textual form beneath the user name referred to as "points". These points, however, should not be mixed up with the actual value of votes for a comment as they refer to another concept called "karma points". According to Reddit's FAQs (Reddit, 2013) the concept of karma "reflects how much good the user has done for the reddit community" with "the best way to gain karma is to submit links that other people like and vote for". Karma, therefore, is Reddit's concept of user reputation. Users with more "karma points" do not have any advantage over users with less "karma points". The structure and layout for comments is displayed in *Figure 33*.

Figure 33. Structure and layout for comments within Reddit stories.

The available ranking options for comments are “best”, “top”, “new”, “hot”, “controversial” and “old”. These rankings refer to the same concepts as known from the ranking options for stories, except for the “best” ranking which is used by default. As described within a post in The Reddit Blog by Munroe (2009), Reddit is heavily biased towards comments posted early. As described above, the ranking algorithm for stories weighs newer stories higher than older stories. However, as far as concerning comments, the “best” ranking is counteracting this bias by displaying good comments at the top and bad comments at the bottom.

> “The reason for this bias is that once a comment gets a few early upvotes, it's moved to the top. The higher something is listed, the more likely it is to be read (and voted on), and the more votes the comment gets. It's a feedback loop that cements the comment's position, and a comment posted an hour later has little chance of overtaking it -- even if people reading it are upvoting it at a much higher rate.”
>
> (Munroe, 2009)

As described by Munroe (2009) the “best” ranking defines the quality of a comment based on the number of people who have voted on a comment. The more people have voted on a comment, the more precisely the quality of a comment can be determined. The number of votes, therefore, is treated as a statistical sampling of a hypothetical full vote by everyone used for calculating the 95% confidence score for a comment. Munroe (2009) illustrates this concept with an example:

> “If a comment has one upvote and zero downvotes, it has a 100% upvote rate, but since there's not very much data, the system will keep it near the bottom. But if it has 10 upvotes and only 1 downvote, the system might have enough confidence to place it above something with 40 upvotes and 20 downvotes -- figuring that by the time it's also gotten 40 upvotes, it's almost certain it will have fewer than 20 downvotes.”
>
> (Munroe, 2009)

Further research into ranking and scores in Reddit has been carried out by Van Mieghem (2011) and Lakkaraju (2012).

4.4 Web-based Q&A

One of the most important aspects within course- or learning management systems is knowledge sharing. Similarly, "one of the most basic ways of finding information is by asking a question to another person" (Chen et. al, 2010). Knowledge can be distributed online via price-based and community-based services whereas such services are often referred to as knowledge markets, question-and-answer services or question-and-answering communities (Chen et. al, 2010; Roush, 2006; Gazan, 2006). Within this research, however, such services are referred to as Web-based Q&A sites (Web-based Question-and-Answering sites).

This chapter will focus on community-based services for Web-based Q&A in terms of review and evaluation of concepts of usability, interface and interaction design. Certain aspects of such services and platforms will consciously be omitted within this review as they do not fit in with the scope of this research. In contradiction to reviews and evaluations in Chapter 3, Chapter 4.2 and Chapter 4.3 this chapter will not expand on specific platforms of such services but rather investigate features, concepts and principles that are shared among different platforms of such services.

Similar to Social News Aggregators also Web-based Q&A fits in with the context of Social Networks and Web 2.0. This is because of rising significance regarding community value and principles known from Social Networks and Web 2.0 in the scope of Web-based Q&A. Anderson et. al (2012) describe the shift towards community-driven question answering in Web-based Q&A:

> "While most Q&A sites were initially aimed at providing useful answers to the question asker, there has been a marked shift towards question answering as a community-driven knowledge creation process whose end product can be of enduring value to a broad audience. As part of this shift, specific expertise and deep knowledge of the subject at hand have become increasingly important, and many Q&A sites employ voting and reputation mechanisms as centerpieces of their design to help users identify the trustworthiness and accuracy of the content."
>
> (Anderson et. al, 2012)

As the above statement clarifies, reputation and voting is crucial to Web-based Q&A. Many of those concepts and mechanisms were first introduced by *Stack Overflow*[1] considered one of the most successful focused Q&A sites (Anderson et. al, 2012). In this context, the term *focused* means that Stack Overflow focuses on a specific range of topics, i.e. crowd-sourced programming solutions (Oshiro, 2009). Stack Overflow was founded in 2008 by Jeff Atwood and Joel Spolsky and lead to establishment of *Stack Exchange*[2], a network consisting of individual communities such as Stack Overflow each dedicated to a specific field of interest. According to Anderson et. al (2012) Stack Overflow "has played a major role in shaping the current paradigm for on-line question-answering, as more than 80 other Q&A sites have adopted the same basic platform". Actually, many of the discussion forums used in MOOCs that are described in Chapter 3 are based on concepts and principles that were either first introduced by Stack Overflow or are best known by the use of Stack Overflow.

Features and principles that are used by Stack Overflow and other Web-based Q&A sites include tagging or categorization of questions, voting (or some kind of value and significance representation in regards to ranking), reputation (reflection on how much trust a user has earned from the community and what actions the user is permitted to do, in consequence), collective knowledge (the asker of the question can validate answers or select the right or the best answers) as well as interface options for filtering or sorting questions and answers. Questions in Stack Overflow are divided into "Top Questions" and "All Questions". In each section different options for filtering or sorting are available. The available filters within the "Top Questions" section are "interesting" (default filter that displays questions that may be interesting to a user based on history and tag preferences), "featured" (questions with an active bounty whereas a bounty is regarded as a reputation award that is given and funded by the personal reputation of the asker), "hot" (question with the most views, answers and votes within the last few days), "week" (same as "hot" but within the last week) and "month" (same as "hot" but within the last month). The available filters within the "All Questions" section are "newest" (standard filter that displays the newest/recently asked questions), "featured" (same as "featured" within the "All Questions" section), "frequent" (questions with the most links), "votes" (questions

[1] See http://www.stackoverflow.com.

[2] See http://www.stackexchange.com.

with the most votes), "active" (questions that have recent activity) and "unanswered" (questions that have no up-voted answers).

In *Yahoo! Answers*[1], another popular Web-based Q&A site, however, a lower number of filtering and sorting options is available. This is because in Yahoo! Answers the process of questioning and answering is slightly different. In Stack Overflow, users can answer questions regardless of time and answers by other users and vice versa the asker can select one of the answers as the best one. In Yahoo! Answers, in contradiction, questions can have three different statuses: open, in voting and resolved. These statuses, at the same time, indicate the available filters in Yahoo! Answers. New questions are "open" for others to answer for 4 days per default (the time period can be extended or shortened). After this period has elapsed the asker can either choose the best answer by himself/herself or let the community vote for the best answer. Such questions are then "in voting". After voting has been finished questions are "resolved". Within each of these filters questions can additionally be sorted by the options "newest", "most popular" (regarding votes) and "most answers". All options for filtering and sorting are available in each category within Yahoo! Answers. In contrast to Stack Overflow categories as well as sub-categories are used for classification of questions instead of tags. Questions can be posted within exactly one category whereas categories are pre-defined in Yahoo! Answers. In Stack Overflow, however, multiple selections of tags are provided whereas tags can be freely chosen by the user which corresponds to the principle of folksonomy as already described in Chapter 3.2. In Stack Overflow as well as in Yahoo! Answers the best answer to a question (which is selected by the asker in Stack Overflow) is displayed on top of all answers, irrespective of the actual sorting of the answers. In Stack Overflow, answers can be sorted by the latest activity (e.g. reply to an answer or a vote), in order that they were provided (oldest) and by the highest voting score. In Yahoo! Answers, answers can be sorted by oldest to newest, newest to oldest or by the highest voting score. In Stack Overflow, the best answer is highlighted with a green "tick"-icon, in Yahoo! Answers it is labeled as "Best Answer", additionally including the asker's rating in form of stars (5 available stars) and a textual feedback. Both concepts of visualizing the best answer to a question are illustrated in *Figure 34*.

[1] See http://answers.yahoo.com.

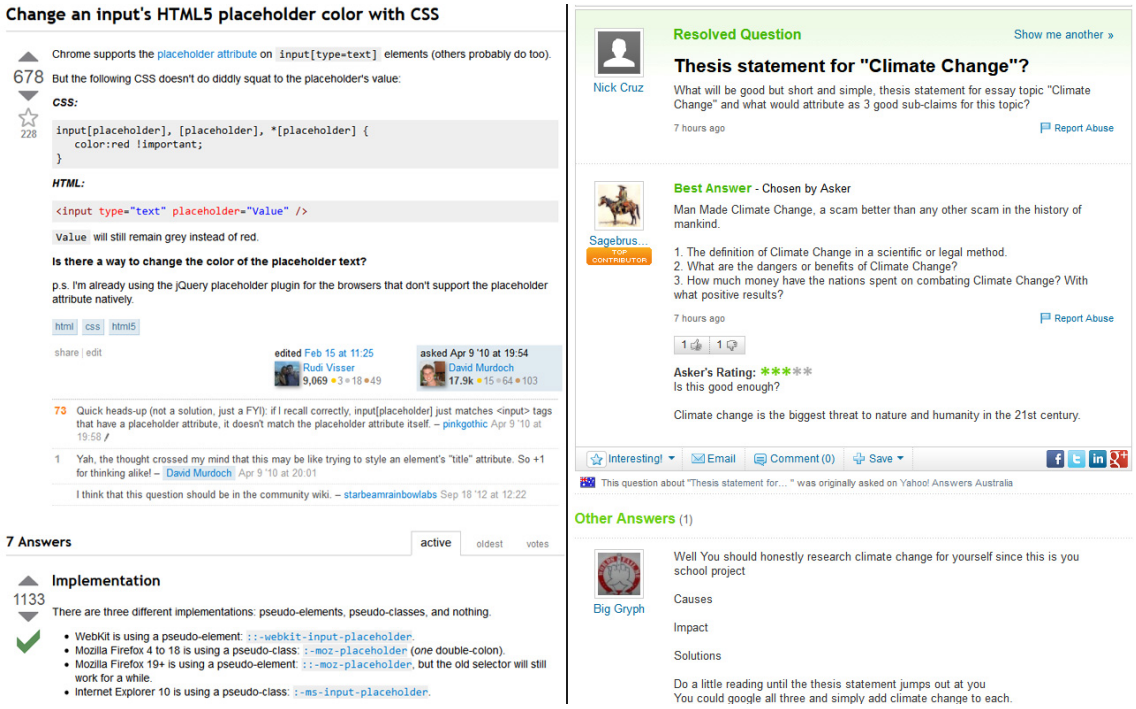

Figure 34. Visualization of „best answer“ in Stack Overflow and Yahoo! Answers.

However, concepts used for same or similar purposes are displayed and represented differently on both platforms. As illustrated in *Figure 34*, in Stack Overflow, the interface element for votes is placed on the left-hand side of a question or an answer and exemplified with upturned and downturned arrows as well as the voting score. In Yahoo! Answers, in contrast, the same concept is placed beneath the text of an answer (only answers can be up- or down-voted here) and exemplified by displaying “thumbs-up”- and “thumbs-down”-icons with the respective number of up-votes and down-votes showing up instead of the total score. On both platforms, questions can be favored. In Stack Overflow, this happens via using the “star”-icon beneath the voting elements. In Yahoo! Answers, the button with the “star”-icon and the “Interesting!”-label within the menu bar beneath the question is the appropriate interface element. Favored questions are then available within the “favorites” (Stack Overflow”) or the “star list” (Yahoo! Answers), respectively. In addition to that, in Yahoo! Answers, questions can be emailed to friends or saved to and shared in Social Networks like Facebook, Twitter, Google+[1], LinkedIn[2], Del.icio.us[3]. Another significant difference is that answering in Yahoo! Answers is only possible on one

[1] See http://plus.google.com.

[2] See http://www.linkedin.com.

[3] See http://www.delicious.com

level of hierarchy (i.e. answering to the question) whereas answering in Stack Overflow is possible on two levels of hierarchy (i.e. answering to the question as well as further replying to such answers), similar to most discussion forums described in Chapter 3.3 or Facebook's new approach to Facebook Pages described in Chapter 4.2.1.

Moreover, the approach to framing and provoking questions and answers distinguishes on both platforms. According to observations made by the author of this thesis, in Yahoo! Answers, questions are usually formulated in a more succinct way than in Stack Overflow. Thus, also answers are usually formulated in a more succinct way. This is not only because of the fact that Stack Overflow is a more focused Web-based Q&A site and, therefore, accommodates more complex questions and issues, but also because of the way the user is tempted to write new questions. In Stack Overflow, the user has to click on the "Ask Question"-button and accept some tips regarding questions (e.g. to search for other questions first or to be specific and on-topic when asking). Only then the user is referred to the actual interface for formulating the question. In Yahoo! Answers, however, the interface for asking questions is displayed on top of every page, as illustrated in *Figure 35*. The omnipresent single-line text box tempts the user to formulate quick and short questions. After clicking on the "Continue"-button the user eventually gets a few suggestions on other, already existing questions that might be similar before sending the question that can optionally be further described in more detail later. Most certainly, posting a new question in Yahoo! Answers takes fewer steps and less time. This is also because there are no options for formatting textual content of questions. In Stack Overflow, in contrast, there are a lot of formatting options, not least because of the fact that including code snippets into questions and answers is essential in Stack Overflow. The interface for formulating new questions in Stack Overflow is displayed in *Figure 36*.

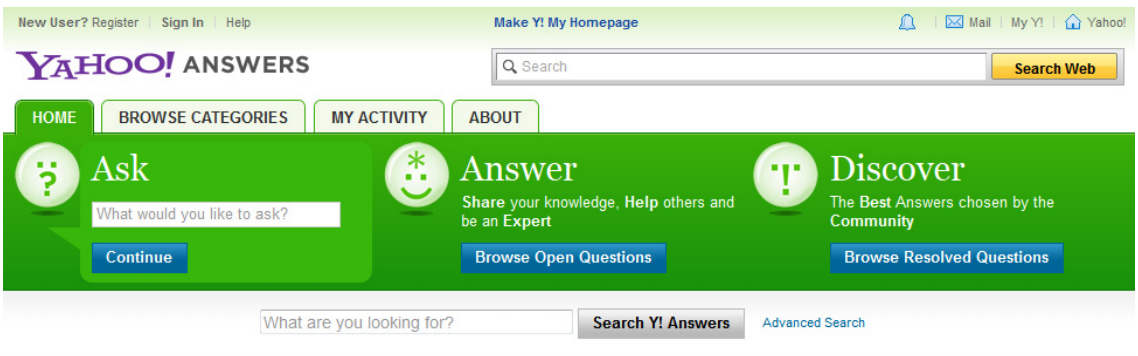

Figure 35. Interface for formulating new questions in Yahoo! Answers.

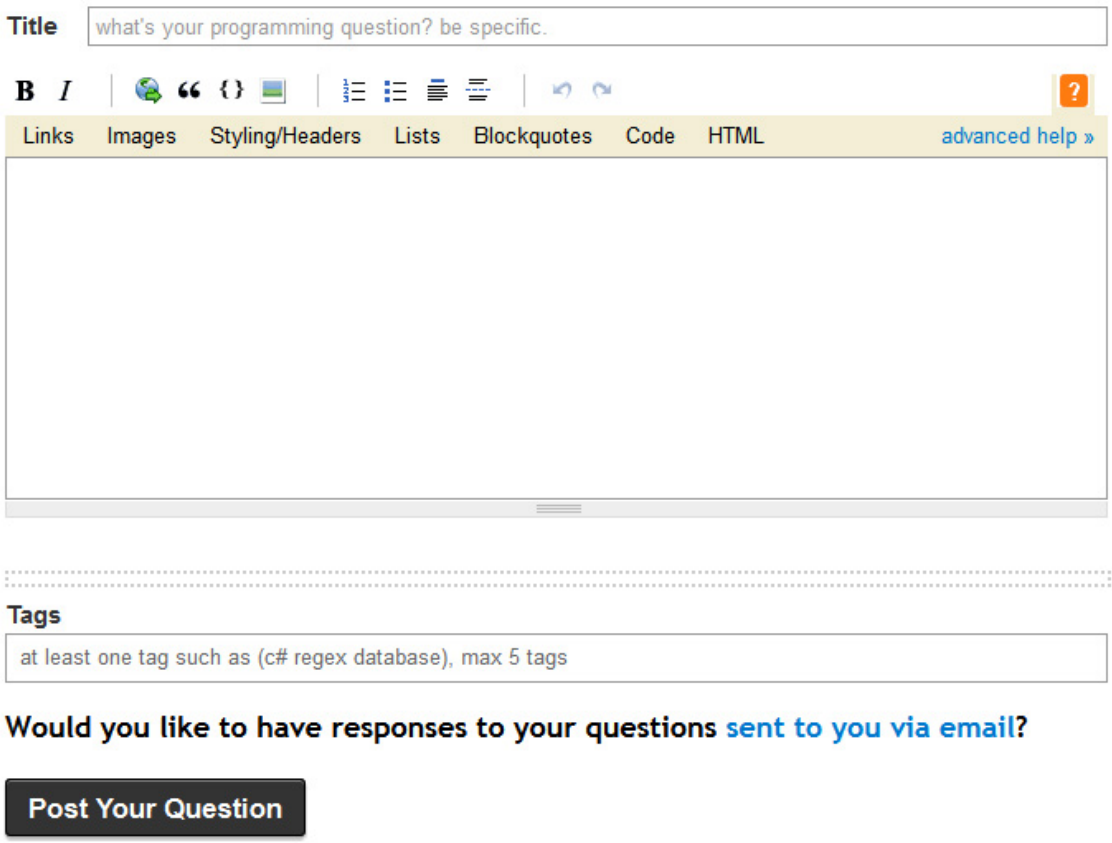

Figure 36. Interface for formulating new questions in Stack Overflow.

Due to these different characteristics Web-based Q&A sites such as Yahoo! Answers are also often used for general kinds of questions such as polls or surveys. This behavior has been observed not only on Yahoo! Answers but also on similar platforms like *Answerbag*[1] which uses same or similar concepts and principles regarding usability, functionality, interface and interaction design. In Answerbag, questions and answers as well as categories are structured similar to Yahoo! Answers and, again, the interface for submitting a new question is displayed as a single-line text box relatively prominent on top of the page. Variant concepts in Answerbag include multiple approval of correct or good answers (by the asker in form of the "asker's pick" as well as by staff, moderators or community leaders in form of a "great answer") or further commenting on answers. As regards the aspect of short and quick questioning, also the Web-based Q&A platform on *Answers.com*[2] can be considered similarly. Its Q&A component is referred to as "The Q&A

[1] See http://www.answerbag.com.

[2] See http://www.answers.com.

wiki" or *WikiAnswers*[1]. As these titles indicate answers are composed collectively in WikiAnswers. There is, therefore, no such thing as answers, replies or comments but on the contrary, there is only the question as well as the answer that is composed collectively. But also questions or at least categories the questions are flagged with can be edited collectively. Interface options are rare as there is no ranking for different answers. However, answers can be improved and contributors as well as questions can be recommended. The structure of a question in WikiAnswers is displayed in *Figure 37*.

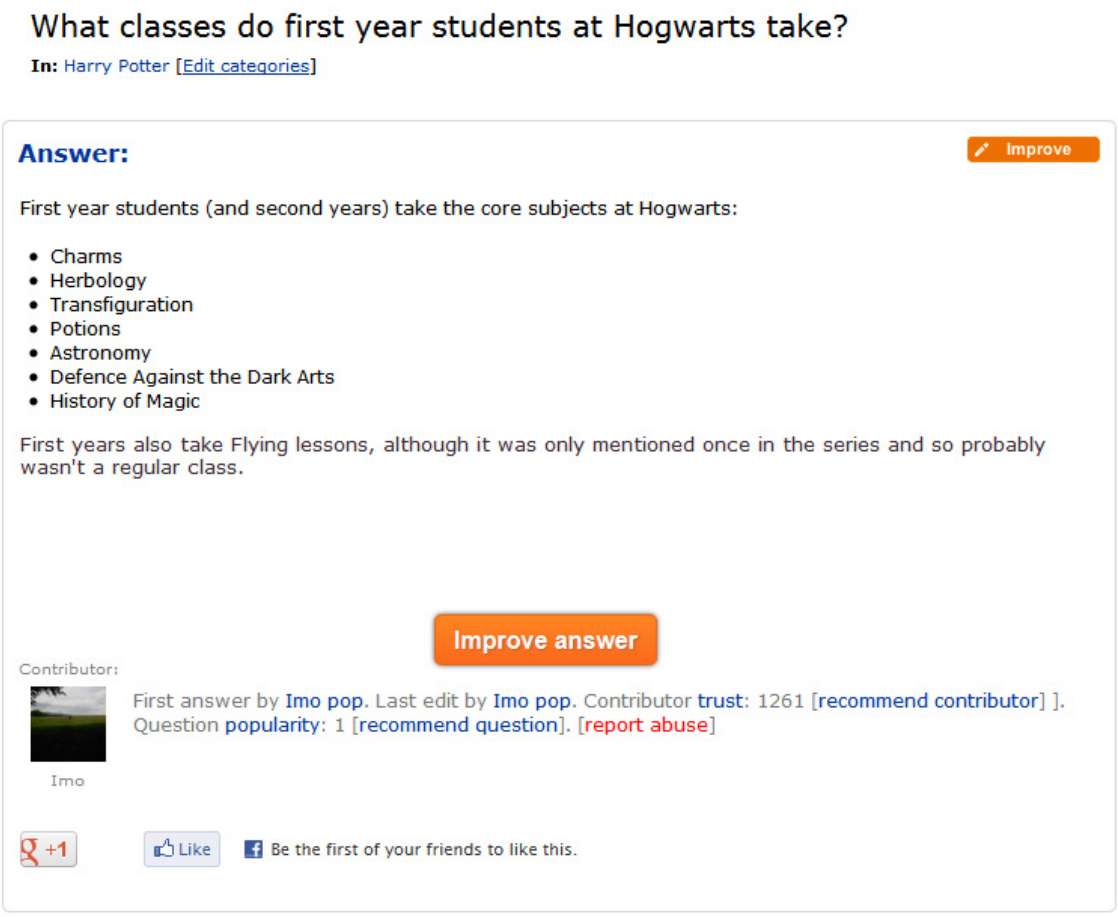

Figure 37. Structure of questions and answers in WikiAnswers.

When clicking on the "Improve answer"-button further interface options become available such as a discussion area, the list of contributors and a history of edits or contributions, respectively. A wiki-like concept of improving answers is also used in Stack Overflow. Despite the fact that there might be several answers by different users there is the possibility of editing answers by others. However, potential edits will be placed in a queue

[1] See http://wiki.answers.com.

until they are peer reviewed if they are initiated by users that do not have enough reputation.

Generally, reputation is an essential principle in most Web-based Q&A sites such as Stack Overflow, Yahoo! Answers or Answerbag. The concept of reputation in Stack Overflow (as well as the concept of badges that is also used in Stack Overflow) has already been described in Chapter 3.3.2 as it is also used in the Q&A software *OSQA* which is considered highly influenced by Stack Overflow (Enfew, 2010). A detailed description of reputation, additional privileges and badges in Stack Overflow is provided by its FAQs[1]. Reflecting Stack Overflow's concept of reputation on sites like Yahoo! Answers or Answerbag, the respective concepts are called "Points" and "Levels". In Yahoo! Answers, users gain or lose points by performing specific actions such as asking and answering a question or voting for an answer. With the increase of points the so-called level of a user is also increasing. The higher the level, the more a user can contribute to the platform. Hence, the concept of levels in Yahoo! Answers is comparable to the concept of reputation points in Stack Overflow. However, the respective level in Yahoo! Answers is less reflected on what actions a user can perform but rather on how often a user can perform specific actions. A detailed description of points and levels in Yahoo! Answers is provided by its "About Yahoo! Answers" site[2]. Similar concepts in Answerbag are also referred to as "points" and "levels" but do rather indicate a user's recognition by the community then further privileges. A detailed description of points and levels in Answerbag is provided by its site guidelines[3].

In addition to Web-based Q&A communities like the ones that have just been mentioned software systems, open source as well as commercial software systems, are used for establishing Q&A platforms. Above all, this is functional for restricted domains or bigger platforms that can install such systems as add-ons. The MOOC providers Udacity and edX that have been described in Chapter 3.3.2 and Chapter 3.3.3 are perfect examples of that. However, the concepts and principles of such systems will not be further described within this thesis as, according to observations by the author of this thesis, these concepts and principles are primarily derived and adopted from Stack Overflow. Also Anderson et. al

[1] See http://stackoverflow.com/faq and http://stackoverflow.com/badges.

[2] See http://answers.yahoo.com/info/scoring_system.

[3] See http://www.answerbag.com/guidelines/#point_on_ans.

(2012) describe that "more than 80 other Q&A sites have adopted the same basic platform" as Stack Overflow. Examples of open source Q&A software systems are OSQA, Askbot[1] or Shapado[2]. An example of commercial Q&A software is AnswerHub[3] which refers itself to as "Answer Management for the Enterprise". OSQA as well as AnswerHub are both powered by *DZone*[4] who published a White Paper comparing features and characteristics between the open source solution OSQA and the enterprise solution AnswerHub (DZone, 2012).

4.5 Social Software in Higher Education

In this chapter, as a last point of the chapter "CMC in Web 2.0 and Social Software", results and findings from studies and research regarding the use of Social Software and Social Networks within the scope of Higher Education will be presented. This chapter reflects on general conclusions of respective studies and considers Social Networks like Facebook or Twitter as described in Chapter 4.2 within the context of Higher Education. In addition to that, also the use of other Social Software in this context like wikis or weblogs as well as state-of-the-art solutions regarding Social Software in Higher Education will be evaluated or referenced, respectively.

The majority of research papers and case studies regarding the use of Social Software and Social Networks within the scope of Higher Education are focusing on the integration of Facebook into processes of communicating, teaching and learning in Higher Education. General conclusions in this field include that the quality of the educational act between teachers and students can be contributed significantly by using Facebook (Grosseck et. al, 2011). However, a research by Shona & Warren (2011) showed that students are used to using Facebook in an informal manner and thus not wanting to formally engage educationally using Facebook. The majority of Facebook's use is related to social interaction and not to work, business or teaching. Therefore, students do not feel connected using Facebook in a work related sense. According to Luckner (2011, p. 49), further disadvantages when using Facebook in an educational context include that

[1] See http://www.askbot.org or https://github.com/ASKBOT/askbot-devel.

[2] See http://www.shapado.com or https://github.com/ricodigo/shapado.

[3] See http://www.answerhub.com.

[4] See http://www.dzone.com/links/about.jsp.

Facebook accommodates a lot of chances for distraction, issues on privacy and security may arise and excessive use of Social Networks with decreasing personal interaction can cause isolation. Advantages when using Facebook in an educational context, however, according to Luckner (2011, p. 48), include experience in using Facebook, independence of time and space, access to discourse and course material and the influence of students on teaching and learning content.

In contrast to Facebook which is mainly used in an informal manner, as stated above, Twitter has a more formal context to receive information. According to Shona & Warren (2011) this is because on Twitter students or people in general are used to receiving information in short text form from people or organizations they are interested in. Thus, there is also less expectation on students to engage in discussions or active participation than in Facebook. However, despite the rather formal character of receiving information in Twitter, Ebner et. al (2009) found out that microblogging can also support informal learning and process-oriented learning. Ebner et. al (2009) state that too many restrictions prevent informal learning and that factors such as being part of someone else's process by reading, commenting or discussing are considered relevant to microblogging in formal education. Case studies conducted by Holotescu & Grosseck (2009) and Luo & Gao (2012) investigate the use of microblogging platforms specially designed for the context of education and business. The respective platforms evaluated in these studies are Cirip.ro[1] and Twiducate[2].

Blogging in a rather traditional form is established through the use of weblogs. Downes (2004) states that using weblogs in Higher Education persuades students to learn new skills such as reflecting own work or writing to a public audience. Lujan-Mora & Juana-Espinosa (2007) identify further advantages when using weblogs in Higher Education including: helping to create connections between students with diverse opinions and interests, facilitating to share knowledge and information, promoting higher levels of thinking, improving coordination and allowing interaction to greater extent. However, Lujan-Mora & Juana-Espinosa (2007) also identify some disadvantages or barriers, respectively, including: difficulty in assessing student participation as well as general points of criticism of CMC as discussed in Chapter 2.3.

[1] See http://www.cirip.ro.

[2] See http://www.twiducate.com.

Duffy & Bruns (2006) discuss the use of blogs, wikis and RSS in education regarding characteristics, educational benefits and educational uses of these technologies. Especially the educational benefits of wikis are highlighted as this technology is designed for collaborative authorship and writing over time whereas teacher and learners are able to see the evolution of a document. In a report published by the University of Delaware (2008) wikis are described as not meant to be true but meant to be discussed. This statement fits in well with the context of lectures aimed at a large number of students or MOOCs, respectively. As mentioned in Chapter 3.3, all of the described MOOC providers have wikis integrated into their courses.

In addition to Social Networks, weblogs or wikis that are integrated into the context of Higher Education, there are also social software products that have been designed especially for Higher Education. Besides software systems like Cirip.ro and Twiducate that have been mentioned above, also projects like *Hotseat*[1] and *Social Media Classroom*[2] are considered relevant. Luckner (2011, pp. 55-58) describes the concepts of those products whereas Hotseat is a project by Purdue University which allows students and teachers to communicate with each other within a backchannel by using their already existing Facebook- or Twitter accounts. The system provides functionalities such as micro-discussions, ranking, questions and answers. The Social Media Classroom project that has been initiated by Howard Rheingold integrates a variety of social software systems such as wikis, forums, blogs, chat rooms or social bookmarks. Students work with these technologies and participate in collaborative tasks and discussions. On the website of the Social Media Classroom, the project is described as "an invitation to grow a public resource of knowledge and relationships among all who are interested in the use of social media in learning" which "is made public with the intention of growing a community of participants who will take over its provisioning, governance and future evolution".

[1] See http://www.itap.purdue.edu/studio/hotseat/.

[2] See http://www.socialmediaclassroom.com.

5 The Project

This chapter covers the practical part of this research. As already discussed in the Introduction of this thesis, this refers to implementing a prototype and integrating it into the newest generation of the e-learning framework of the Human Computer Interaction working group of the Institute of Design and Assessment of Technology, Faculty of Informatics, at the Vienna University of Technology.

This chapter starts with a history and an overview of concepts and principles of the e-learning framework which has just been addressed and will be referred to as *Portfolio* throughout this chapter. Thereafter, conception, design, development and implementation of the prototype will be described. As already addressed in Chapter 1.3 this process is based on Exploratory Research and Design. Further insights into the development process will be given in Chapter 5.2.1. The description of the project will also include thoughts and ideas about initial feature sets (Chapter 5.2.2), the process of sketching and prototyping in reference to relevant literature (Chapter 5.2.3), architecture and technical details of the prototype (Chapter 5.2.4) as well as an overview of final concepts and components of the prototype at the time of finishing the research within this thesis (Chapter 5.2.5). Evaluation of the prototype will be covered in Chapter 6.

5.1 The "Portfolio" project

The *Portfolio* is a project centered around the exploration of teaching and learning in times of omnipresent internet access. It was initiated by Prof. Peter Purgathofer[1] in 2008 and has been implemented, extended, applied and evaluated since then. Throughout the years, the project has been implemented and used in varying versions and forms with different types and components. The software has mainly been developed by students and research assistants in the scope of theses, papers and practical works.

[1] See http://igw.tuwien.ac.at/designlehren/Site/Welcome.html.

The project's motives have already been addressed briefly in Chapter 3.1. As discussed by Purgathofer & Reinthaler (2008) lectures in Higher Education that are aimed at a large number of students and conducted in a traditional form encounter problems and issues like anonymity (needs and wants by individuals cannot be considered), lack of discourse and feedback (only a minimum number of students gets a chance to speak), sparse interaction between teachers and students and are mainly based on teacher-centered teaching. The *Portfolio* project has been evolved because of these problems and is designed for supporting such lectures in a way that students can better focus on actual contents of the lecture, also out of class and despite of the large number of participating students. It is even considered one core property of the system that it becomes more valuable as more students participate, just as described as one of the main principles of Web 2.0 applications in Chapter 4.1.

The most significant features and components of the project or the platform, respectively, include user management (in connection with the "single sign-on" authentication service[1] of Vienna University of Technology), the dashboard and the news feed (as a starting page with an overview of important dates, basic information, FAQs and the global communication channel, i.e. the news feed), the slidecasting (providing lecture slides live during the lecture with the possibility to comment on topics that are discussed right at that very moment and are also available after and out of class), activities (overview of open, accepted and evaluated assignments with the possibility to accept or hand-in individual as well as group assignments) and an overview of grading points and statistics.

During and at the end of this research, version 3 of the project (Portfolio 3.0) was still in development by a group of students of Vienna University of Technology who have been implementing new, revised and extended functionalities and concepts within the scope of a practical work. In consequence, some of the concepts might no longer fit to the description given by Luckner (2011, pp. 59-108) or might have been renamed (e.g. activities have been renamed to challenges and slidecasting has been renamed to slides).

The prototype established by the author of this thesis has been, therefore, integrated into a premature version of Portfolio 3.0. As already described in the Introduction, research within this thesis and, thus, the respective prototype primarily focus on terms of

[1] See http://www.zid.tuwien.ac.at/sts/dateninfrastruktur/authentifizierungsservice/single_sign_on/.

communication. Hence, neither the development of the practical part of this research nor the project description will go into detail on aspects that are not relevant for communication or the scope of this research, respectively.

However, a further description of the evolution and motives of the Portfolio project and its characteristics and components (by status of 2011) is provided by Luckner (2011, pp. 59-108).

5.2 The prototype

As already addressed in the Introduction the practical task within this research was to conceive, design, implement and evaluate a unified and new, contemporary approach to course-related communication. As stated in Chapter 1.2, the term "unified" in this context refers to unification of concepts and approaches regarding different types of communication as well as communication about different types of course-related content. Insights into research and evaluation of the state-of-the-art regarding computer-mediated communication in Higher Education (Chapter 3) as well as Web 2.0 and Social Software (Chapter 4) are considered relevant and should have influence on the prototype as several aspects of these fields are regarded as significantly valuable by the author of this thesis for the scope of CMC in Higher Education. For example, students are used to Social Networks like Facebook and Twitter and regard those as common. They are used to usability and interface concepts such as "liking" or commenting. Apart from that, probably the most important paradigm in course-related communication is questioning and answering as it is applied in Web-based Q&A platforms. Furthermore, with the wave of MOOCs, systems are evolving which are oriented to a large-scale audience and provide concepts and principles for communicating within a large-scale audience.

The prototype within this research will be developed as a "news feed" or "posts" component that can be integrated into e-portfolios or e-learning frameworks, both as a standalone news feed and as a plug-in to provide context-related communication to different types of content such as activities or slides. Within this research, it will be integrated into a premature version of Portfolio 3.0 that might have changed radically after end of this research.

5.2.1 Guidelines, principles and development process

As already discussed the prototype within this research is built within an Exploratory Research and Design process. This means that within this iterative process including activities such as design and evaluation in each iteration cycle, in parallel to research and evaluation of computer-mediated communication in Higher Education (Chapter 3) as well as Web 2.0 and Social Software (Chapter 4), the prototype evolved as a result of design meetings. These meetings have taken place at the Human Computer Interaction working group of the Institute of Design and Assessment of Technology, Faculty of Informatics, at the Vienna University of Technology and were guided by Prof. Purgathofer. Other students concerned with the development of Portfolio 3.0 as well as Naemi Luckner, research assistant at the HCI group at time of this research, have participated in some of those meetings. Insights into the theoretical research of the author of this thesis as well as exploratory approaches to reflecting on and evaluating the prototype have influenced the design meetings. Following the meetings, respective prototypes have been implemented and/or adapted according to concepts and changes the participants of the meetings have decided on. The prototype as is at the end of this research is, therefore, a result of exploratory research and collaborative design processes.

As it is intended to evaluate usability, interface and interaction design of the prototype at a high rate, the author of this thesis implemented the prototype according to specific usability guidelines and approaches that will be described next alongside with definitions of terminologies such as “usability” or “interaction design” that are considered relevant to the scope of this research. Interaction design, often abbreviated *IxD*, is about shaping digital things for people’s use whereas shaping in this context is used consciously to suggest a designerly activity (Lowgren, 2013). Winograd (1997) regards interaction design as interdisciplinary science which is not a sub-field of computer science:

> “While drawing from many of the older disciplines, it has a distinct set of concerns and methods. It draws on elements of graphic design, information design, and concepts of human-computer interaction as a basis for designing interaction with (and habitation within) computerbased systems. Although computers are at the center of interaction design, it is not a sub-field of computer science.”
>
> (Winograd, 1997)

Regarding terms as “interface design” or “interaction design” computer scientist Bill Buxton[1] rather prefers to use the term “experience design” which he describes as the most human-centric of such terms.

> “Despite the technocratic and materialistic bias of our culture, it is ultimately experiences that we are designing, not things. Yes, physical objects are often the most tangible and visible outcomes of design, but their primary function is to engage us in an experience [...]”
>
> (Buxton, 2007, p. 127)

Buxton’s approaches to sketching user experience do also fit in with the science of Exploratory Research and Design and do, therefore, have influence on the design process of the prototype.

As regards the term “usability”, it is often mistakenly equated only with the meaning of “user-friendliness”, according to usability expert Jakob Nielsen (1993, pp. 23ff). Nielsen states that computers do not need to be user friendly but rather need to not stand in the user’s way:

> “Back when computer vendors first started viewing users as more than an inconvenience, the term of choice was "user friendly" systems. This term is not really appropriate, however, for several reasons. First, it is unnecessarily anthropomorphic-users don't need machines to be friendly to them, they just need machines that will not stand in their way when they try to get their work done. And second, it implies that users' needs can be described along a single dimension by systems that are more or less friendly. In reality, different users have different needs, and a system that is "friendly" to one may feel very tedious to another.”
>
> (Nielsen, 1993, p. 23)

Furthermore, Nielsen (1993, p. 26) describes usability not as a single, one-dimensional property of a user interface but rather as an interplay of the following attributes:

[1] See http://www.billbuxton.com/.

Attribute	Description
Learnability	The system should be easy to learn so that user can rapidly start getting some work done.
Efficiency	Once the user has learned the system, a high level of productivity should be possible.
Memorability	The user should be able to return to the system after they have not used it for some time without the necessity to learn it again.
Errors	The lower the error rate of the system the better. The user should be able to easily recover from errors whereas catastrophic errors (e.g. system crashes) should not occur at all.
Satisfaction	The user should be subjectively satisfied when using the system.

Table 2. Usability principles according to Nielsen (1993, p. 26).

The characteristic stating that systems should not stand in the user's way indicates that clear and simple structures with self-explanatory interface elements and options are desirable. This also corresponds to Steve Krug's "Don't make me think!"-approach to modern web design which requires websites and web applications to be built in a way that does not make the user need to think (Krug, 2006).

> "It's the overriding principle - the ultimate tie breaker when deciding whether something works or doesn't in a Web design. If you have room in your head for only one usability rule, make this the one [„Don't make me think"]. It means that as far as is humanly possible, when I look at a Web page it should be self-evident. Obvious. Self-explanatory."
>
> (Krug, 2006, p. 11)

Krug's "common sense approach" will also be considered valuable within the design process of the prototype that will be built in the scope of this research.

5.2.2 Initial Feature Sets

At the beginning of the design process of the prototype desired features had to be determined. These features have been defined during the previously mentioned design meetings with alternations in priority, concepts and functional principles from meeting to meeting. Thus, just as the design process as a whole also definition and determination of features was a result of a collaborative process and theoretical research of computer-

mediated communication in Higher Education (Chapter 3) as well as Web 2.0 and Social Software (Chapter 4).

Initial Feature Set		
Feature	**Description**	**Priority**
Structure of posts	Posts include: • a title and content that can be formatted by using a web text editor; • date, number of views, number of up- and down-votes (including the respective users), user information (nickname, avatar, etc.), number of favorites/saves; • tags that are pre-defined and individually available for students (e.g. "question"- or content-related tags) and teachers (e.g. "announcement"-, "dates"- or "organization" tags)	high
Replying, editing and deleting posts	Users should be able to edit and delete their posts (administrators can edit and delete all posts). Every user should be able to reply to posts.	high
Up- and down-voting	Users should be able to up-vote and down-vote posts.	high
Good questions and good answers	Administrators should be able to mark questions or answers with a "Good question"- or "Good answer"-flag.	high
Saving posts	Users should be able to save posts to a "favorite"- or "personal"-area	medium
Attachments	Users should be able to add attachments to posts.	low
Private posts	Users should be able to limit visibility of posts to a private audience (e.g. groups) only.	low
Ranking & filtering	Users should have the possibility to rank (e.g. "new" or" hot") and filter (e.g. "saved", "questions", specific tags) posts.	high
Linking posts to dates	Administrators should be able to link specific posts to specific dates (e.g. to a specific lecture or exam date)	low
Highlighting good posts	For posts with a relatively high number of replies the system should automatically and intelligently highlight the best posts (regarding number of up-votes or flags by administrators) and hide other posts (that can be faded in on demand).	medium
Connection to Social Networks	It should be possible for users to optionally connect the system to their Social Networks (e.g. Facebook or Twitter) for publishing posts or replies also there with default configurations as well as per-post configurations.	medium

Table 3. Initial feature set of the "posts" prototype.

The initial feature set differs a lot from the feature set implemented in the current version of the prototype as is at the end of this research. Feature sets have been defined with feature names, descriptions and priorities (high, medium, low). The initial feature set is illustrated in *Table 3*. At time of defining the above feature list it has been left open if features with low priority will be implemented at all as a lower number of features rather comprehend the usability guidelines and principles that have been described in Chapter 5.2.1. Thus, the initial feature set has been limited to the following extent throughout the research in order to provide clearer and simpler structures and interfaces. Apart from that, also time of research was limited, so some features needed to be redefined and only implemented if time permits.

Limitations of the Initial Feature Set	
Feature	**Limitation**
Structure of posts	• Titles for posts will be omitted • Formatting of posts will be implemented in terms of a markup syntax (time permitting) • Number of views, user information in votes and number of favorites/saves will be omitted
Replying, editing and deleting posts	• Deleting can be problematic for detailed discussions and posts with lots of answers (left open / time permitting)
Attachments	• Attachments will be omitted
Private posts	• Left open / time permitting
Linking posts to dates	• Left open / time permitting
Highlighting good posts	• Considered highly valuable but also very complex and depending on several aspects as well as on a reliable algorithm (time permitting)
Connection to Social Networks	• Considered as a nice-to-have but not essential (time permitting)

Table 4. Limitations of the Initial feature set of the "posts" prototype.

The reader should note that not all of the above defined features are yet included in the current version of the prototype as is at the end of this research. All final features, concepts and components are described in Chapter 5.2.5. A technical description of the implementation of the prototype is provided in Chapter 5.2.4.

5.2.3 Prototyping

Prototyping has several definitions such as "an original model after which anything is copied"[1] but in the context of this research prototyping is applied in the sense of "externalizing and making concrete a design idea for the purpose of evaluation" (Munoz, 1992). According to Arnowitz et. al (2007, p. 4) a prototype is any attempt to realize any aspect of software content. This may include interaction, navigation, hierarchical schemes or information design. Nielsen (1993, pp. 93ff) suggests prototyping for early usability evaluation supporting fast and cheap development. Furthermore, Nielsen distinguishes between vertical prototyping and horizontal prototyping.

> "Cutting down on the number of features is called vertical prototyping since the result is a narrow system that does include in-depth functionality, but only for a few selected features. [...] Reducing the level of functionality is called horizontal prototyping since the result is a surface layer that includes the entire user interface to a full-featured system but with no underlying functionality"
>
> (Nielsen, 1993, p. 95)

The prototype built within the scope of this research cannot be clearly allocated to vertical or horizontal prototyping. This is because on one hand the "posts" prototype represents a specific component or detail of the Portfolio 3.0 system with no considerations about some other aspects of Portfolio 3.0. On the other hand the "posts" prototype does also represent in-depth functionality for a high number of features. More essential than the distinction between vertical and horizontal prototyping is the selection of the proper prototyping method.

> "Prototypes are designed to answer questions. The quantity and kind of questions that generate prototypes are at the heart of prototyping culture. Different questions may require different kinds of prototyping media."
>
> (Winograd & Schrage, 1996)

[1] Webster's 1913 Dictionary.

As the initial prototypes within this research are concerned, the *Wireframe Prototyping* method has been selected. According to Arnowitz et. al (2007, pp. 273ff), Wireframe Prototyping is a narrative prototyping method that uses sketches and is suitable especially in the initial stages of the design process serving as a basis for further prototyping such as *Paper Prototyping* or *Digital Prototyping*. By using Wireframe Prototyping specific use cases or general concepts and structures can be illustrated and mediated. Thus, wireframe prototypes are usually not used for evaluating purposes but rather presenting basic concepts and structures in order to agree on those in compliance with the design team or the customer. When using Wireframe Prototyping the designer is free to select the level of abstraction as well as the appropriate medium (e.g. sketches on paper or sketches using a graphic program). A scan of the initial wireframe prototype sketched on a piece of paper is displayed in *Figure 38*.

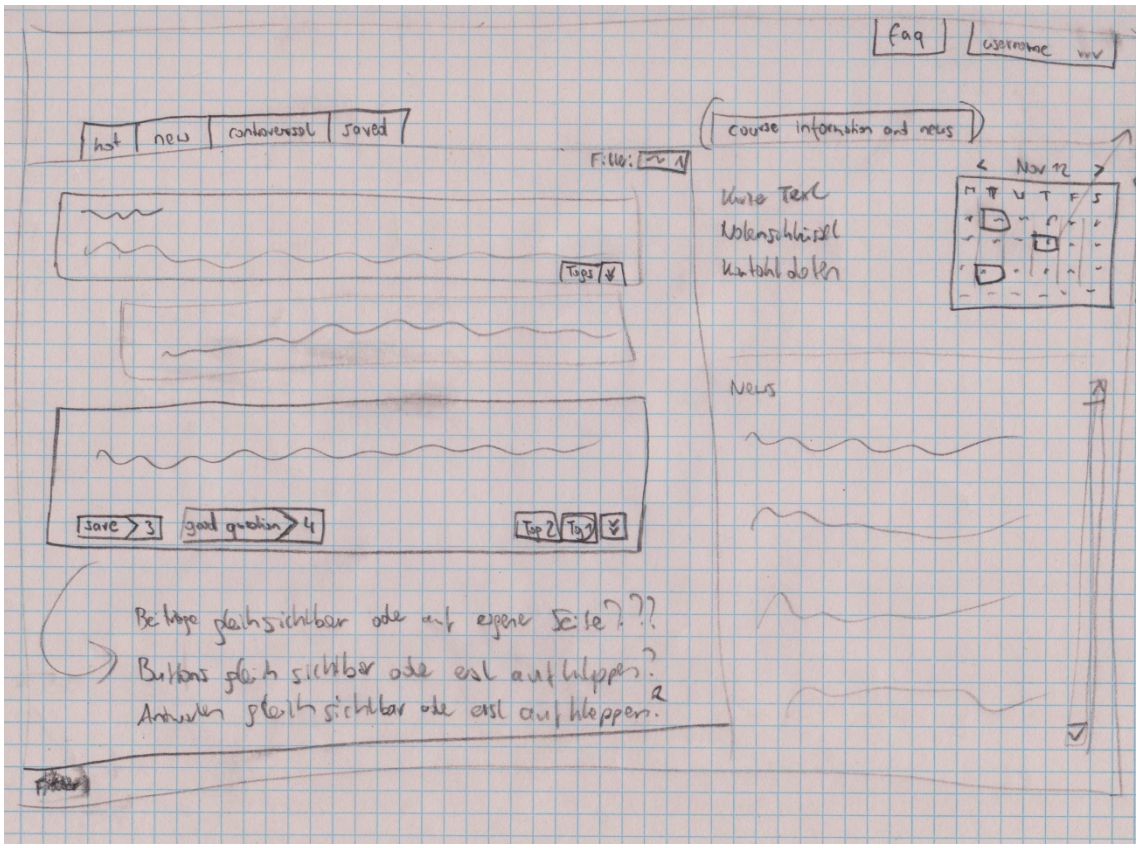

Figure 38. Initial wireframe prototype for "posts".

The initial wireframe prototype illustrates basic concepts such as tabs for filtering and ranking, interface options for posts like saving, marking as good questions or tags, the general structure of posts and replies as well as a right frame including a calendar and announcements. The wireframe prototype illustrated in *Figure 38* additionally contains

notes to better describe specific concepts or to register specific aspects that need to be defined more clearly. For example, at the time of designing the initial wireframe prototype it was not yet clear whether interface options for posts will be visible instantly, get faded in on mouseover/hover or get fold out on clicking on a specific element. The second wireframe prototype which illustrates this concept more clearly with interface options placed at the top right corner of posts (desired to be faded in on mouseover/hover) is displayed in *Figure 39*. Furthermore, in the second wireframe prototype, the select box for filtering is displayed more prominently and an interface element for voting on posts is included. The series of thin lines above the last reply in the wireframe prototype indicates posts that are hided (as described with the "Highlighting good posts" feature in Chapter 5.2.2).

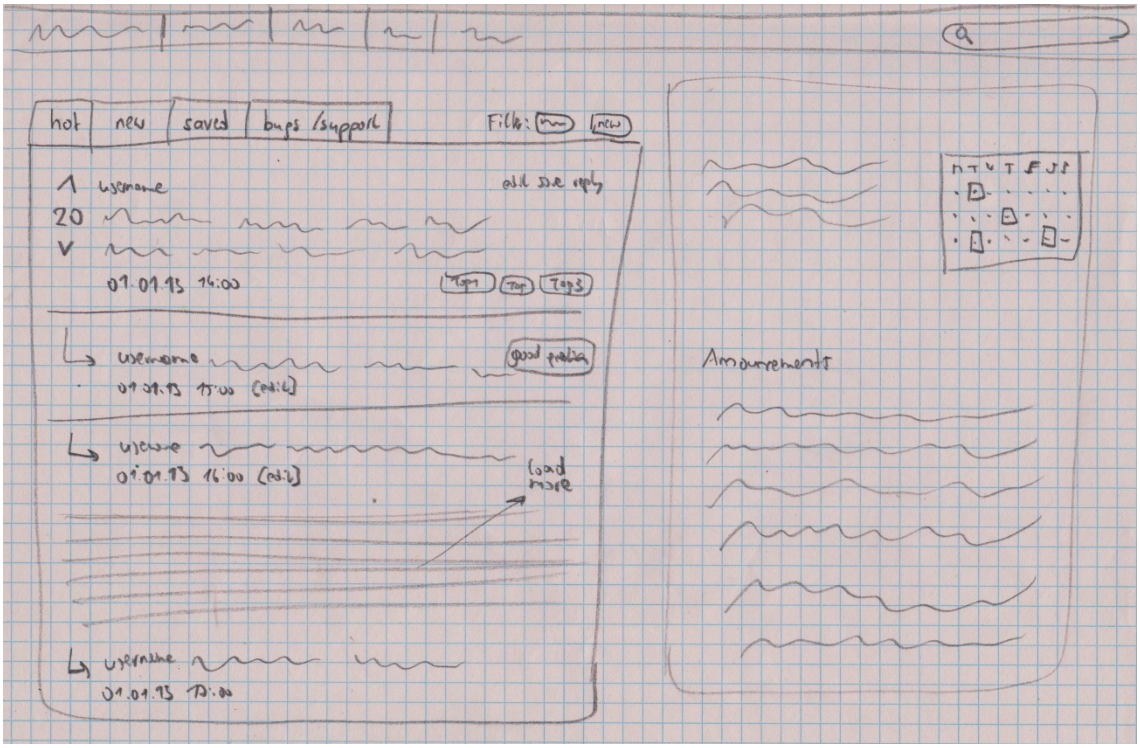

Figure 39. Second wireframe prototype for "posts".

Following the wireframe prototypes, *Digital Prototyping* has been conducted. According to Arnowitz et. al (2007, pp. 343ff), Digital Prototyping is an interactive as well as an narrative prototyping method. It can visualize specific states of the system simulating interaction but also lets the user explore the system by itself. Digital prototypes can be consulted for evaluation and tests but the designer should be aware of the fact that Digital Prototypes might still be incomplete in regards to actual functionality.

Within the scope of this research digital prototypes have been built based upon the previously designed wireframe prototypes. They are built as static webpages by the use of HTML[1], CSS[2] and JavaScript[3] and represent aspects and details such as structure and layout of posts, mouseover effects and some interaction. However, most interface options are not implemented within the first digital prototype. Thus, as far as the digital prototypes of this research are concerned they can be regarded as horizontal prototypes including the entire user interface but with no underlying functionality (first digital prototypes) or less underlying functionality (final digital prototypes). The first digital prototype of this research is displayed in *Figure 40*.

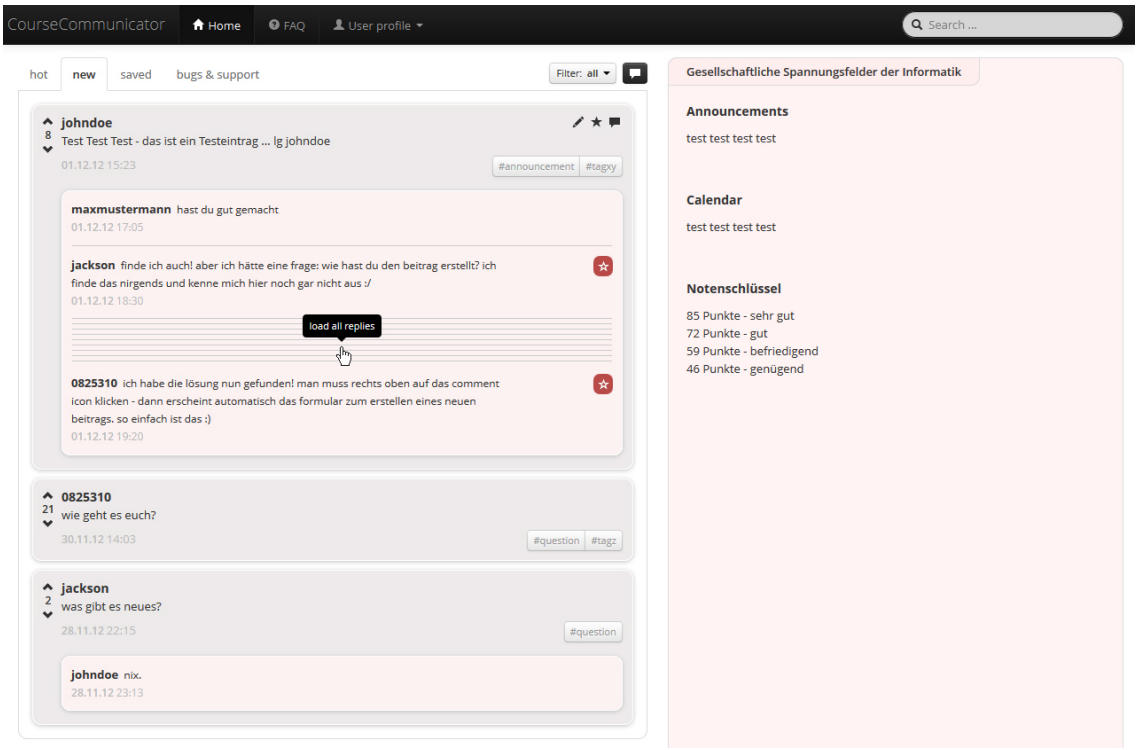

Figure 40. First digital prototype for "posts".

As *Figure 40* illustrates, interface elements for voting are included for first level posts (but not for replies), hided replies are represented by thin lines and "good questions" or "good answers" are visualized by red highlighted "star"-icons. Furthermore, dates and tags of posts as well as interface elements for posts (editing, saving, replying) are included. At this point it was not yet clearly defined whether replies should be aggregated in a global area

[1] HyperText Markup Language, see http://en.wikipedia.org/wiki/HTML.

[2] Cascading Style Sheets, see https://en.wikipedia.org/wiki/Cascading_Style_Sheets.

[3] See http://en.wikipedia.org/wiki/JavaScript.

for each post (as illustrated with the white box in *Figure 40*) or whether each reply should be represented by its own white box, as displayed in *Figure 41*.

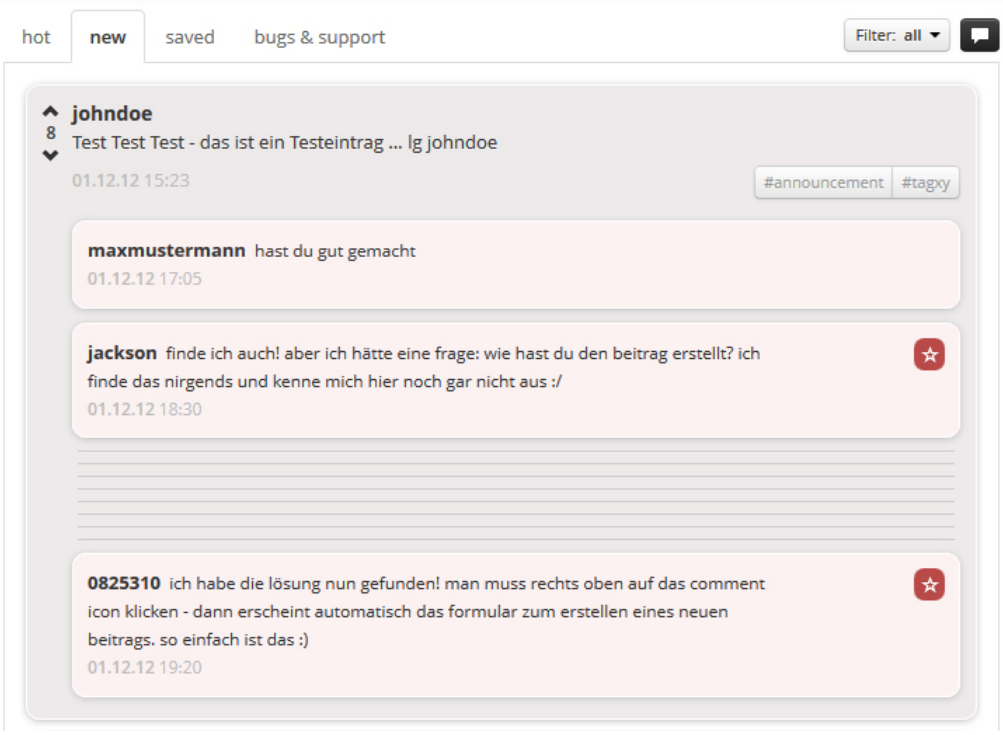

Figure 41. Alternate representation of replies within the first digital prototype for "posts".

Following several design meetings, the author of this thesis and the researchers who have participated in those design meetings agreed on some changes for further digital prototypes, including:

- Posts, replies and site background need to be separated more clearly.
- Encouraging clear separation, gradients (e.g. for tags) should only be used when necessary (e.g. for buttons) and shadows need to be applied more beneficial (e.g. for separating posts more clearly from the site background).
- Voting should also be provided for replies.
- Dates of posts and replies need to be placed in a way that saves space (no new line break) and should be displayed in relative time.
- The thin lines indicating hided replies can be placed closer to each other to save space.

- The avatars of users need to be displayed.
- A more suitable interface concept of “good questions” and “good answers” needs to be designed.

Reflecting on and implementing those changes in a further digital prototype resulted in the prototype, illustrated in *Figure 42*.

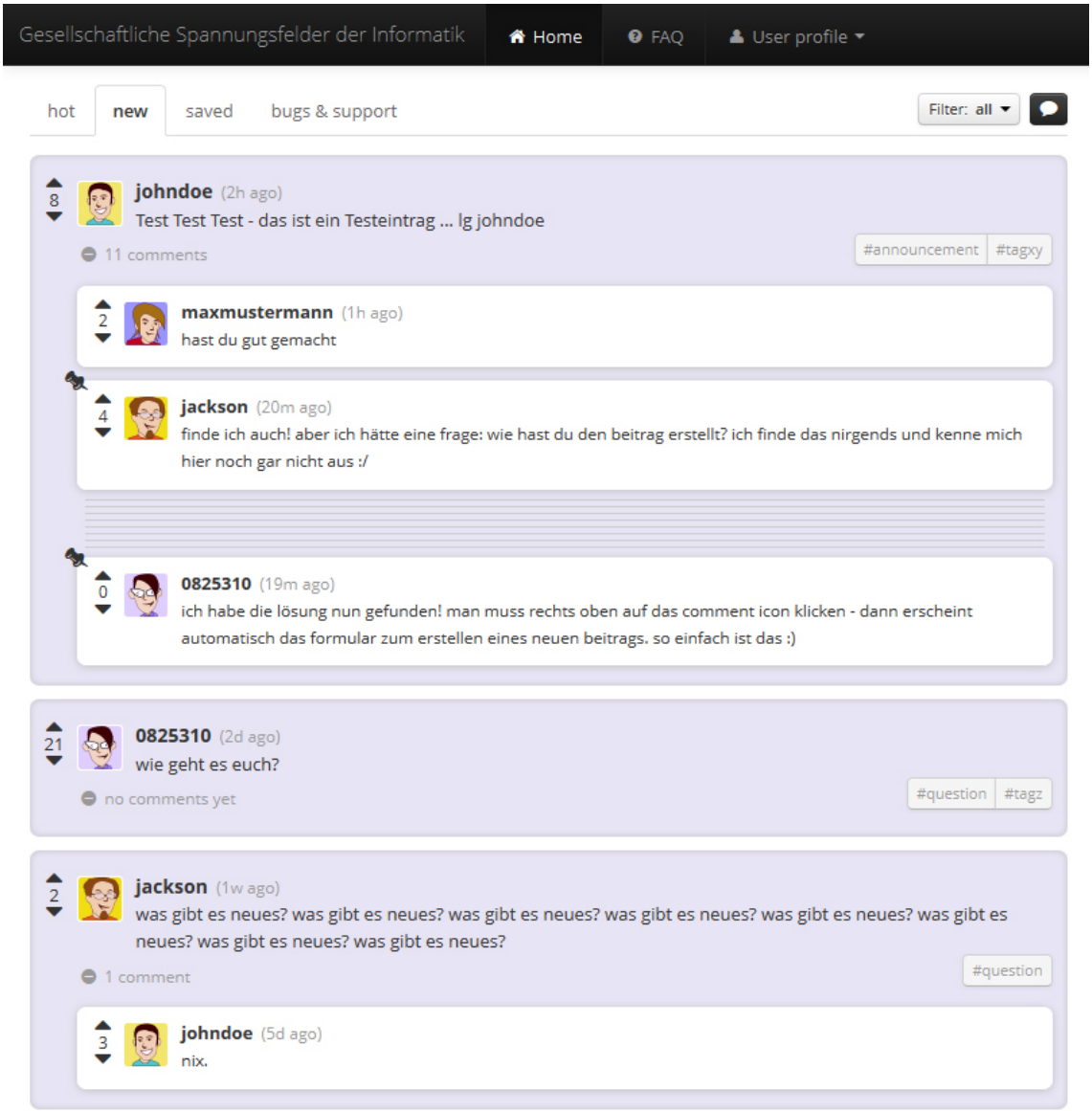

Figure 42. Second digital prototype for “posts“.

Following further design meetings, the author of this thesis and the researchers who have participated in those design meetings agreed on two additional changes:

- The interface elements for voting should be highlighted in a brighter color (grey instead of black) to set more focus on the actual content. Furthermore, the interface elements for voting for replies should be placed outside the white box as there is free space and thus remaining more space for the actual content of replies.

- The newly chosen interface element for “good questions” and “good answers” (a “pin”-icon) could be misconceived as a pin usually indicates something that is actually pinned on top of the page which is not the case within this context.

Consideration of these two changes resulted in a final digital prototype, illustrated in *Figure 43*. As regards the interface element for “good questions” and “good answers” appropriate icons have been designed (“question”-sign for questions, “tick”-icon for answers) that are placed alongside with a respective information phrase below the text of a reply.

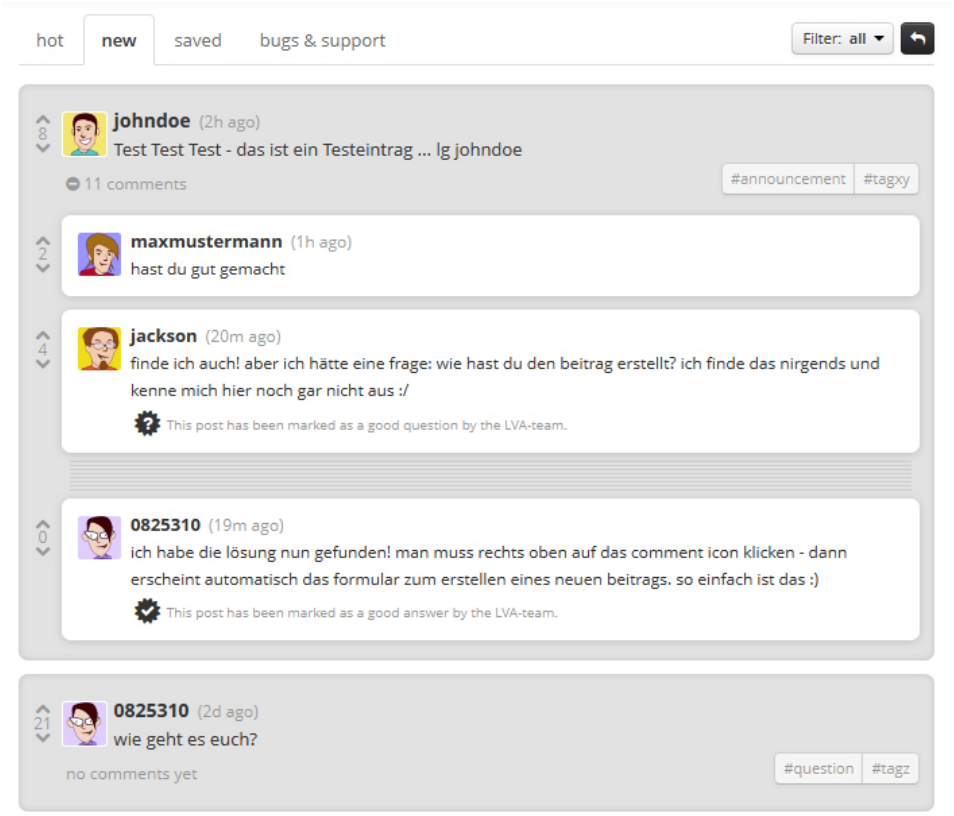

Figure 43. Final digital prototype for “posts“.

The final digital prototype is regarded as a basis for the *Coded Prototype* which can be considered the prototype that is used for testing and evaluation within this research.

According to Arnowitz et. al (2007, pp. 421ff), Coded Prototyping is a prototyping method that implements concepts, structures and principles from paper prototypes or digital prototypes by using programming- and/or scripting languages. Coded prototypes usually provide complete functionality and, in contrast to other prototyping methods, get integrated into the final product using code snippets of the coded prototype.

The coded prototype within this research will be further described in Chapter 5.2.4 and Chapter 5.2.5.

5.2.4 Technical Documentation

Portfolio 3.0 is developed via the Python[1]-based open-source web framework *Django*[2] which is described on its website as "a high-level Python Web framework that encourages rapid development and clean, pragmatic design". Django loosely follows a Model-View-Controller (MVC) pattern[3] separating code for defining and accessing data (the model), request-routing logic (the controller) and the user interface (the view) (Holovaty & Kaplan-Moss, 2009, p. 6).

Since Portfolio 3.0 is based on Django it is obvious that also the "posts" prototype developed within this thesis uses Django as a web framework. However, in addition to Django, various other technologies are integrated into the prototype. In the background of the system an Apache[4] webserver with *ModPyhton*[5] is running. *MySQL*[6] is used as the database server.

Layout and structure of the prototype are implemented using *HTML(5)* and *CSS* whereas two specific CSS frameworks are integrated. Twitter's *Bootstrap* framework, as addressed in Chapter 4.2.2, is used to empower interface elements and user interaction such as forms, buttons, tab menus, select boxes or alerts. Furthermore, the framework *Font Awesome*[7] is integrated which is described on its website as "the iconic font designed for

[1] See http://www.python.org/.

[2] See https://www.djangoproject.com/.

[3] See http://en.wikipedia.org/wiki/Model%E2%80%93view%E2%80%93controller.

[4] See http://www.apache.org/.

[5] See http://www.modpython.org/.

[6] See http://www.mysql.com/.

[7] See http://fortawesome.github.io/Font-Awesome/.

use with Twitter Bootstrap". In the context of the "posts" prototype Font Awesome is particularly used because of its relatively large assortment of icons in regards to web applications. Using the Font Awesome framework icons are not embedded as graphics but as a font. Therefore, icons can be embedded vectorized providing free choice in sizing and coloring.

One of the main objectives of the prototype was to conform to the characteristics of Web 2.0 applications as discussed in Chapter 4.1 and Chapter 4.2. This is why certain aspects of the system have been redesigned within the wireframe prototypes and digital prototypes as described in Chapter 5.2.3 and also why frameworks like Bootstrap or Font Awesome have been integrated. But one of the essential aspects of the prototype was to provide interactive and asynchronous interaction with as few page reloads as possible. Thus, the integration of *AJAX* (as described in Chapter 3.2.2) is considered crucial. Within the context of the "posts" prototype this is accomplished by the integration of the JavaScript frameworks *jQuery*[1] and *AngularJS*[2]. Whereas jQuery is already considered a well-established JavaScript framework useful in almost every scripting situation providing a general-purpose abstraction layer for common web scripting (Chaffer & Swedberg, 2007, p. 6), AngularJS is a rather young JavaScript framework, initially released in 2009 and super-powered by Google since 2010. Therefore, this thesis will not go into detail on the use of jQuery but rather describes the use of AngularJS as it is integrated heavily into the "posts" prototype. AngularJS is described on its website as "what HTML would have been had it been designed for applications". One of the primarily design goals is to provide Model-View-Controller capability to browser-based applications.

> "AngularJS is a structural framework for dynamic web apps. It lets you use HTML as your template language and lets you extend HTML's syntax to express your application's components clearly and succinctly. Out of the box, it eliminates much of the code you currently write through data binding and dependency injection. And it all happens in JavaScript within the browser making it an ideal partner with any server technology."
>
> (AngularJS, 2013)

[1] See http://jquery.com/.

[2] See http://angularjs.org/.

Basic concepts and principles included in AngularJS are illustrated in *Table 5* (AngularJS, 2013; Sprehn, 2011). The reader should note that the namespace of AngularJS is called "ng"[1].

Basic concepts and principles of AngularJS	
Concept	**Description**
Declarative markup	Declarative markup provides including HTML partials (ng:include), looping over collections/arrays (ng:repeat), showing or hiding elements based on conditions (ng:show / ng:hide), adding or removing classes from elements (ng:class) or handling user interactions (e.g. ng:click / ng:change).
Custom HTML tags and attributes	For supporting declarative markup, so-called directives[2] can be built with underlying functionality and program logic. Directives can be placed in element names, attributes, class names and comments.
Two-way data binding	Automatic synchronization of data between the model and view components is provided. Thus, changes in the model are automatically reflected in the view and vice versa[3].
Form validation	Integrating Angular-models into forms provides validation services with instant feedback for better user experience[4].
Dependency injection	Dependency injection is provided dealing with how code gets hold of its dependencies[5].
RESTful resources	A resource service is provided for interacting with RESTful server-side data sources and APIs in AJAX[6].
Service abstraction	Services can be defined for use in controllers that can easily swapped out for testing[7].
Scopes	Scopes are objects that refer to the application model as an execution context for expressions with no more global state[8].

Table 5. Basic concepts and principles of AngularJS.

[1] See http://docs.angularjs.org/misc/faq.

[2] See http://docs.angularjs.org/guide/directive.

[3] See http://docs.angularjs.org/guide/dev_guide.templates.databinding.

[4] See http://docs.angularjs.org/guide/forms.

[5] See http://docs.angularjs.org/guide/di.

[6] See http://docs.angularjs.org/api/ngResource.$resource.

[7] See http://docs.angularjs.org/guide/dev_guide.services.understanding_services.

[8] See http://docs.angularjs.org/guide/scope.

For further reading on the subject of AngularJS the author of thesis recommends the AngularJS Developer Guide[1]. According to the author of this thesis, the most challenging part in implementing the "posts" prototype is the integration of Django and AngularJS. Prior to this, the structure of the Django code is about to be described. Django's documentation[2] recommends sub-dividing Django projects into several components that can be joined together. This way, sub-components of a project such as "posts" in the frame of Portfolio 3.0 can be integrated when needed and left out otherwise. Thus, the "posts" prototype is designed and implemented as a Django app integrated into the Portfolio 3.0 project. A django app usually consists of models (definition and access of data), views and templates (providing the user interface) and urls (defining specific routes for the web browser that retrieve views and templates). As regards the models of "posts" it was considered a requirement to define those in a simple way, as described in *Table 6*.

Models of the "posts" prototype/app	
Model	**Description**
Post	The primarily model including information about the parent post (for replies), the user id of the author, the respective course (as several courses might be available in Portfolio 3.0), the publication date of the post, the text, the average value of votes, a flag for good posts (e.g. "good question" or "good answer") and the respective content type (e.g. the news feed or other content types such as challenges or slides).
Tag	Available tags that can be selected for posts.
PostTag	The relation between posts and tags.
PostVote	The relation between posts and votes (including the respective user and the value of the vote, i.e. up-vote or down-vote).
PostBookmark	The relation between posts and bookmarks (saving of posts).

Table 6. Models of the "posts" prototype/app.

As regards the integration of AngularJS the author of this thesis decided to build a RESTful API by using the Django package *Tastypie*[3] that easily allows accessing or writing data to the models via AngularJS. Within Tastypie the required API methods have been defined and implemented that, in further consequence, are accessible via the AngularJS

[1] See http://docs.angularjs.org/guide.

[2] See https://docs.djangoproject.com/en/1.4/.

[3] See http://django-tastypie.readthedocs.org/en/latest/.

controllers. Furthermore, with this architecture, models and views are even more decoupled. This would potentially allow easy exchange of frontend or backend, e.g. by integrating Django's RESTful API into other frontends and, on the contrary, integrating other server side technologies or other RESTful APIs into the frontend and the controllers of AngularJS. The Django resources of its RESTful API are defined as models within the AngularJS controllers communicating data in JSON[1] format. This way, actions such as writing, editing, filtering and ranking posts are handled corresponding to the design principles of AngularJS without page reloads or extensive server requests. Apart from that, AngularJS within the context of this prototype is used for DOM manipulation (e.g. hiding or showing elements), declarative markup and form validation.

5.2.5 Final concepts and components

Based on the final digital prototype for "posts" as described in Chapter 5.2.3 and the technical considerations discussed in Chapter 5.2.4, the coded prototype for "posts" is integrated into Portfolio 3.0. In this chapter, final concepts and components of the "posts" prototype will be described and discussed explicitly. However, the following description will focus on essential parts of the prototype and will, therefore, neither go into detail on minor concepts of the prototype nor on concepts from the Portfolio 3.0 project that are not directly related to the "posts" prototype.

Concepts and structure of the integrated coded prototype of "posts", as shown in *Figure 44*, largely correspond to the concepts illustrated by the final digital prototype in *Figure 43*. For the greater part, the feature set defined in *Table 4* is also implemented in the coded prototype. However, some of the features are not yet included at the end of this research as time of this research was limited. Features that are not yet integrated include highlighting good posts or hiding other posts, respectively, and the principle of private posts (both features are still considered highly valuable within the scope of this research and the Portfolio 3.0 project) as well as linkage to Social Networks and connection between posts and dates/calendars (both features are considered not essential).

Regarding functional principles of the coded prototype the design goals and principles of AngularJS are considered relevant, as already addressed before. Interaction without the

[1] JavaScript Object Notation, see http://www.json.org/.

necessity of page reloads is significant and, thus, also asynchronous refreshing of specific parts of the page is regarded important. This is implemented via a polling[1] mechanism that refreshes posts every two minutes so that new posts will get faded into the interface.

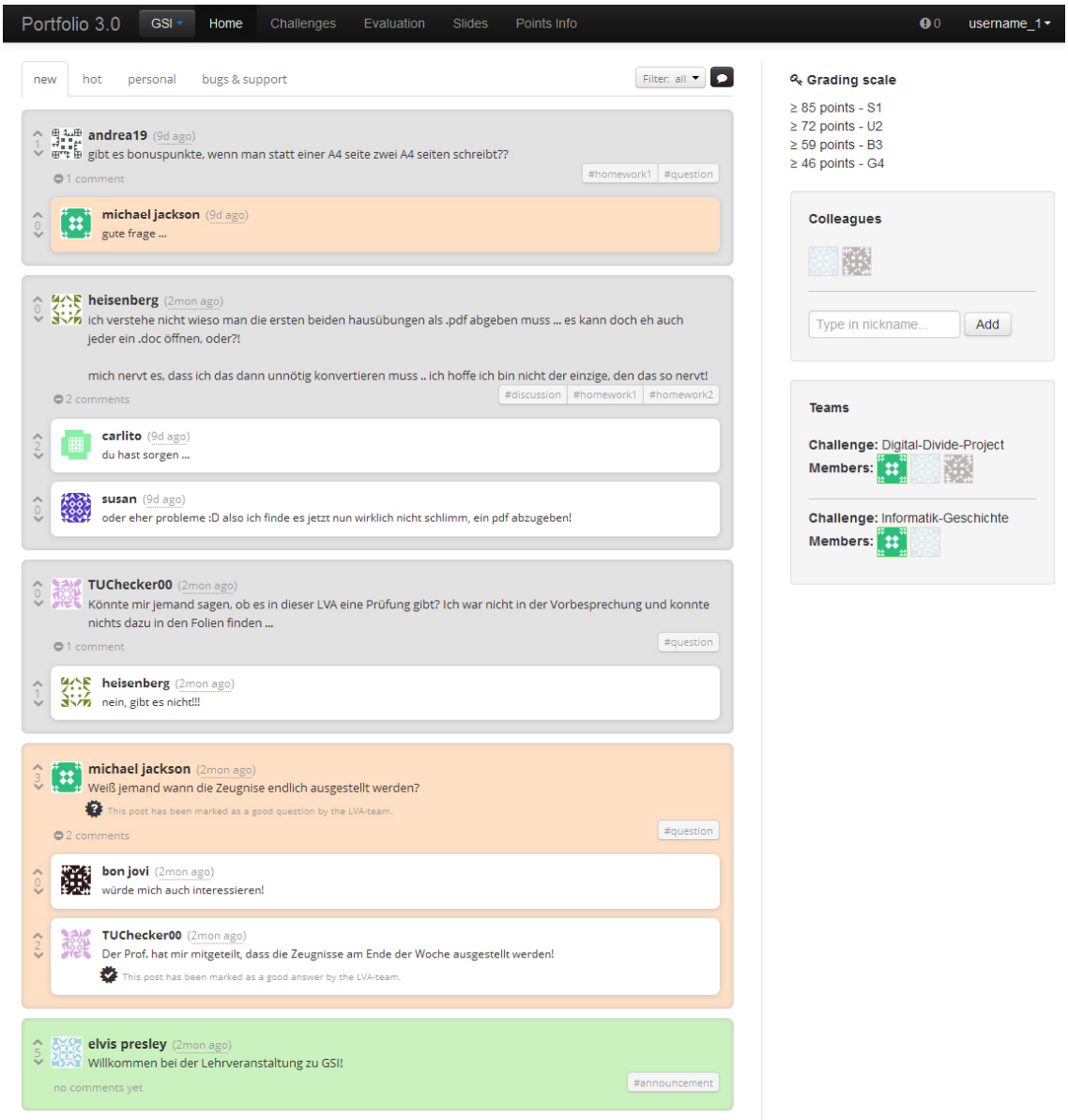

Figure 44. Integration of the coded prototype for "posts" into Portfolio 3.0.

Posts within the news feed (displayed as the starting page of Portfolio 3.0) are categorized into tabs that refer to specific filters and ranking/sorting options. By default, posts are sorted by the latest date ("new" tab) of the starting post. Replies are all visualized as replies to the starting post by one level of hierarchy and can be faded in or faded out by

[1] See http://en.wikipedia.org/wiki/Polling_%28computer_science%29.

clicking on the area displaying the number of comments beneath the starting posts. The "hot" tab sorts posts by the highest average value of votes of the starting post. Factors such as the average voting values of its replies, the number of replies, the number of "good question"- or "good answer"-flags are not yet integrated into this ranking algorithm but considered desirable to do so in order to provide a more sophisticated ranking algorithm such as ranking algorithms of Social News Aggregators (as described in Chapter 4.3) and Web-based Q&A sites (as described in Chapter 4.4). The "personal" tab includes own posts (in regards to the starting post) and saved/favored posts. The "bugs & support" tab, in contrast to the other tabs, does not include the general posts that are included within the other tabs but rather represents a separate news feed. Posts that are posted within the "bugs & support" feed are not displayed within other tabs. This is because it was a requirement to separate course-related posts and system-related posts. In addition to tabs posts can be filtered by all available tags by using the "Filter"-button on the top right corner of the news feed column.

As illustrated in *Figure 43*, the background color of posts might vary. Starting posts have a grey background by default whereas replies have a white background by default. However, own posts and replies (in regards to the user that is logged into the system) do have a red/orange background (the reader should note that in *Figure 43* the user that is logged in has the username "username_1" and the nickname "michael jackson"). Furthermore, posts and replies of staff members do have a green background (in *Figure 43* the user "elvis presley" represents this user group as indicated by the "announcement"-tag and the content of this announcement). The actual selection of the respective background colors for own posts and staff posts (red/orange and green) within this context is not originated by any specific choices.

For adding replies (see *Figure 45*), adding new posts (see *Figure 46*) and editing posts (see *Figure 47*) a simple, auto-validating and auto-growing text box is used. The requirements for successful validation are at least ten characters of text and, additionally for new posts, at least one selected tag. The interface elements for up-voting and down-voting on posts are the upturned and downturned arrows on the left-hand side of posts. The number between those arrows indicates the average value of votes if the average value is greater than zero and zero otherwise. However, the author of this thesis does want to note that this decision might be worth reconsidering possibly also displaying negative values (i.e.

the average value of votes for both positive and negative values). When moving the mouse over the respective values, the number of up-votes and down-votes gets faded in, as shown in *Figure 48*.

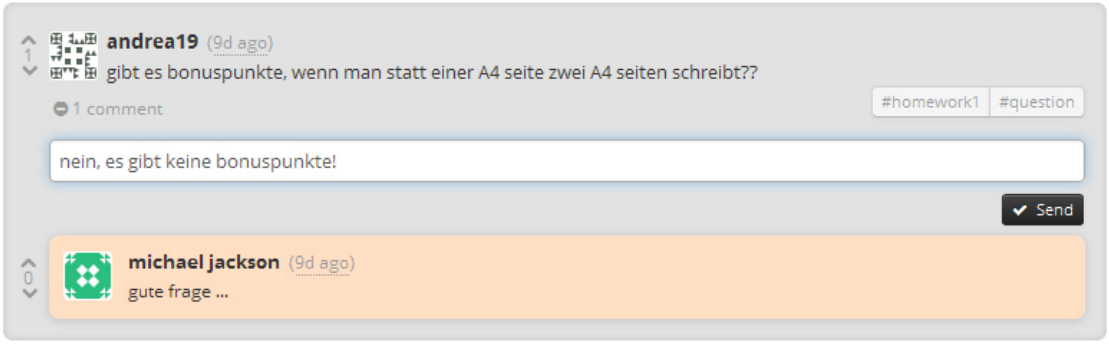

Figure 45. Interface for adding new replies within the coded prototype for “posts”.

Figure 46. Interface for adding new posts within the coded prototype for “posts”.

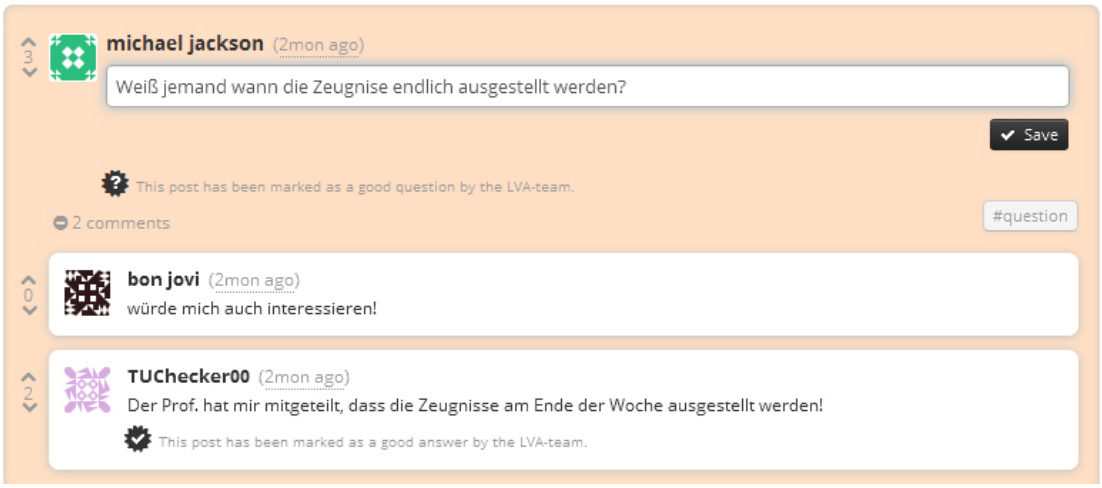

Figure 47. Interface for editing posts within the coded prototype for “posts“.

Figure 48. Number of up-votes and down-votes on mouseover within the coded prototype for “posts”.

Apart from different background colors there is another interface element for distinguishing different types of posts. The “good question”- and “good answer”-flags, as shown within the fourth post from top in *Figure 43*, are designed for highlighting posts that are considered valuable for all users. These flags can be assigned to posts only by staff members and, therefore, interface elements for assigning those flags to posts, as shown in *Figure 49*, are only visible for staff members.

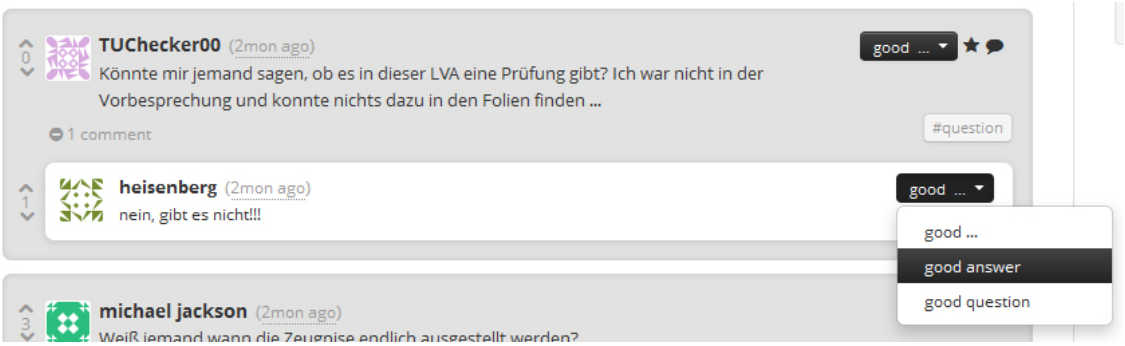

Figure 49. Interface elements for assigning "good questions“ and “good answers“.

All of the previously described concepts of interaction are established by the use of AngularJS and asynchronous calls. Thus, no page reloads are necessary for those interactions. However, changes and results of interactions might not show up immediately which leads to another essential concept and design principle of the coded prototype, namely availability of visual feedback. When interactions are performed and data is loading, the user has to recognize this state, just as discussed within one of the main principles of Web 2.0 applications and Social Networks in Chapter 4.1 and Chapter 4.2. Within the coded prototype for posts, this principle is provided by showing up an

animated, spinning circle with declining background, as illustrated in *Figure 50*. In this example, the visual feedback is showing up for editing a post.

Figure 50. Illustration of visual feedback on performed tasks and loading of data/requests.

The above described concepts and structures for posts are defined in a way that these can also be applied to other forms of content than news feeds. As addressed in the Introduction and in previous chapters a requirement of the "posts" prototype is to design it towards a unified approach. Thus, the coded prototype of "posts" should include concepts, principles, design decisions and considerations that are valuable not only for news feeds but also for comment areas or Q&A sections of other kinds of course-related content.

As an example, integrating "posts" into the context of challenges (assignments) within Portfolio 3.0 could result in a comment section or in a public Q&A area in regards to specific challenges, as illustrated in *Figure 51*. The reader should note that these specific posts are related only to the respective challenges and are not available in other challenges or in the previously discussed news feed. As content is related only to its specific context, concepts and principles for usability, interface and interaction design in regards to course-related communication are applied globally. Just as the coded prototype for "posts" is integrated into challenges, it could be integrated the same way into other kinds of course-related content such as slides (with a "posts" area beneath each slide), video streams, student groups or colleague relations.

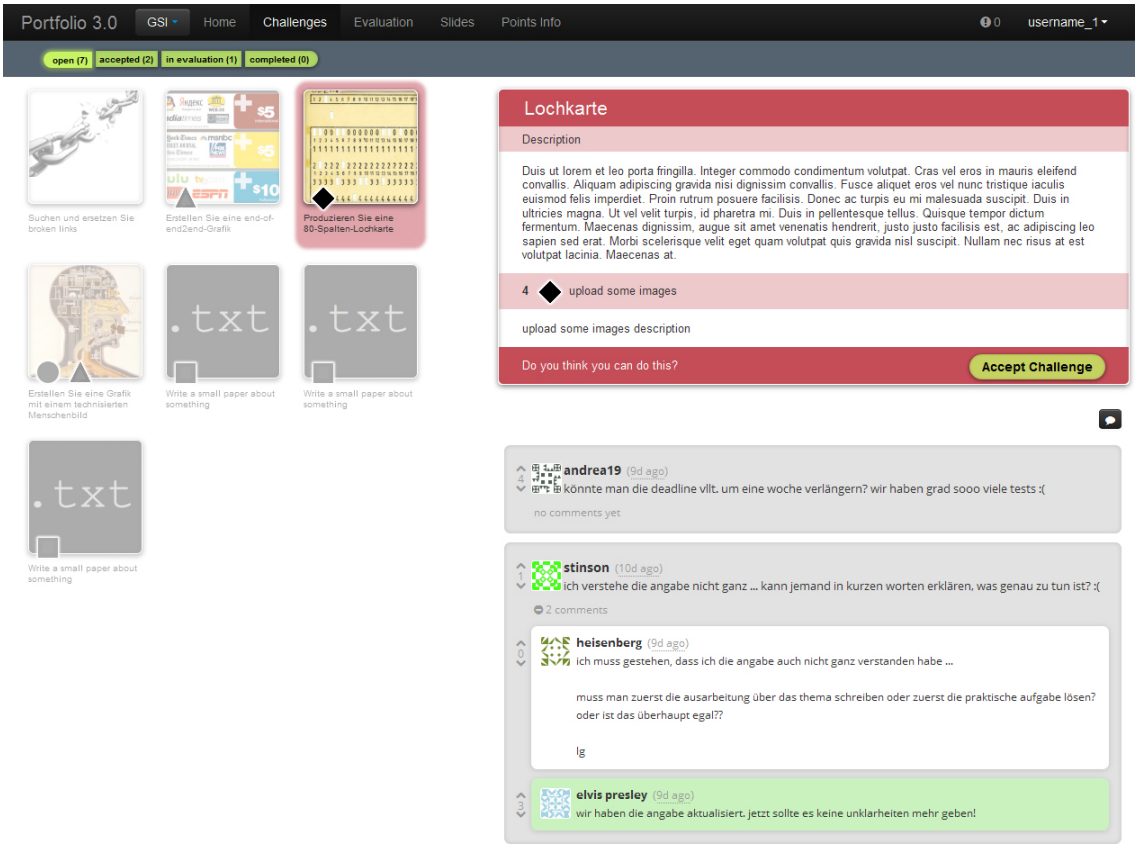

Figure 51. Integration of the coded prototype for “posts” into the context of challenges.

6 Evaluation

Within this chapter the evaluation of the coded prototype for "posts" described in Chapter 5.2 is discussed. As addressed in Chapter 1.3, research into this thesis is based on Exploratory Research and Design. However, evaluation of the coded prototype for "posts" can be considered Qualitative Research and is carried out by qualitative test sessions conducted by the author of this thesis with test users further described as follows.

> "Qualitative research is a situated activity that locates the observer in the world. It consists of a set of interpretive, material practices that make the world visible. [...] This means that qualitative researchers study things in their natural settings, attempting to make sense of, or to interpret, phenomena in terms of the meanings people bring to them."
>
> (Denzin & Lincoln, 2000, p. 3)

In the scope of this thesis, test sessions have been separately conducted with six different test users. The test sessions are comprised of qualitative, semi-structured interviews and usability tests including debriefings. Each test lasted approximately from 60 to 90 minutes whereas introduction into the test session lasted from 5 to 10 minutes, interviews lasted from 30 to 40 minutes, carrying out the usability tests with the respective test tasks lasted from 20 to 35 minutes and debriefings lasted from 5 to 10 minutes. The desired outcome of these test sessions is to answer research questions regarding usability, interface and interaction design of the coded prototype for "posts" and to better define problems and issues within the context of course-related communication.

Considering the coded prototype for "posts" and results of this research might be integrated into the frame of Higher Education and course-related communication, test users for the test sessions have been selected accordingly. As "the main rule regarding test users is that they should be as representative as possible of the intended users of the system" (Nielsen, 1993, p. 175), all of the selected test persons are students. Nevertheless,

they differentiate in characteristics such as age, gender, field of study, computer skills as well as attitude and experience towards course- and learning management systems.

An overview of the test users is provided in *Table* 7.

Overview of test users				
Test user	**Gender**	**Age**	**Computer skills***	**Field of study**
Test user 1	Male	24	Excellent (1)	Business Informatics
Test user 2	Male	23	Excellent (1)	Business Informatics
Test user 3	Female	23	Sufficient (4)	Lectureship for elementary school
Test user 4	Female	19	Average (3)	Chemical science
Test user 5	Male	29	Good (2)	Architecture
Test user 6	Male	25	Good (2)	Civil engineering

Table 7. Overview of test users for evaluation of the coded prototype for "posts".

* In *Table 7*, the numbers within the brackets of the "computer skills"-column indicate how sophisticated the respective user is in reference to dealing with computers.

Further insight into characteristics, attitudes and experience of the test users is provided as follows.

6.1 Qualitative Interviews

At the beginning of each test session and prior to the usability tests discussed in Chapter 6.2 qualitative interviews with the test users have been carried out. The aim of these interviews was to gain further insight into interests, preferences, attitudes, experience and know-how of the test users in relation to subjects considered relevant to the context of this research and the evaluation. According to Birbaumer & Preyer (2010, p. 15) a qualitative interview includes three essential aspects:

- It relates to research questions that want to be explored.
- It is open to "surprises" in terms of aspects of the research that were not anticipated but raised by the interviewed person.

- It supports a narrative procedure encouraging the interviewed person to narrate and illustrate experiences and examples.

The qualitative interviews within the evaluation have been conducted in the form of semi-structured interviews based on notes by the author of this thesis and a range of subjects brought up during the interviews. The subjects that were discussed during the interviews include the internet, Social Networks, Web-based Q&A systems, MOOCs, course- and learning management systems as well as, to a large extent, attitudes, interests, preferences and experience towards course-related communication via the internet. Subsequently, insights into the interviews are discussed. However, some details are not included as they would go beyond the scope of this discussion.

Analyzing the qualitative interviews it is safe to say that the test users use the internet every day or steadily, mainly for the purpose of emails, studying, news, interests and Social Networks. All of the test users know several Social Networks with Facebook being the only Social Network that is used regularly. All of the test users are using Facebook for social reasons with four of the test users using it also for Higher Education (in forms of study groups on Facebook). Two of the test users are additionally using Facebook to follow news on personal interests. However, the majority of the test users describe themselves as interacting passively on Facebook. Only one of the test users, test user 1, states to be interested in trends and changes regarding usability and interface trends of modern web applications and Social Networks. Test user 1 is also the only test user that has consciously and actively used a Web-based Q&A system before. All of the other test users are aware of Web-based Q&A systems but only use such systems sub-consciously when being referred to those by Google.

None of the test users knew about MOOCs before, all test users think that the concepts and ideas of MOOCs are interesting and thus being interested in participating in a MOOC. However, the majority of the test users think that they would not finish such a course due to lack of motivation and commitment. This indicates a subject with lots of conflicting opinions. Two of the test users would favor higher educational courses that are supported online in terms of communication, feedback, questioning and answering or activities, whereas four of the test users prefer teacher-centered teaching because of a more personal connection and relationship to the lecturer. Thus, the majority of the test users also rather prefer to raise questions personally during the lecture or within groups of students than

online. However, two of the test users do also highlight the advantages of online systems because questions or answers might be relevant and helpful also for other students. Hence, all of the test users stated that questions and answers by other students have been helpful to them before.

All of the test users have experienced lectures within their studies that have used more than one online supporting system simultaneously. The majority of the test users would prefer an integrated system including all relevant aspects whereas two of the test users think that separation of specific aspects is reasonable. Concerning requirements of course- or learning management systems, in addition to obvious aspects such as organization, resources and appointment management, the test users regard the possibility to communicate as significant. Within this context, the test users would also prefer communication concepts beyond the scope of common discussion forums but rather context- and content-related communication such as provided by the coded prototype for "posts" described in Chapter 5.2.5.

6.2 Usability Tests

Usability (discussed in Chapter 5.2.1) is considered one of the most essential aspects of the coded prototype for "posts" and information systems in general. Thus, usability tests with the test users have been carried out as usability testing is regarded as one of the most fundamental usability methods (Nielsen, 1993, p. 165).

> "User testing with real users is the most fundamental usability method and is in some sense irreplaceable, since it provides direct information about how people use computers and what their exact problems are with the concrete interface being tested."
>
> (Nielsen, 1993, p. 165)

Nielsen (1993, pp. 165ff) states that usability tests need to be reliable (i.e. providing the same result when the test would be repeated) and valid (i.e. providing a result that actually reflects the usability issues that want to be tested). As almost all usability tests need to include novice users some user interfaces might also need to be tested with expert users (Nielsen, 1993, p. 177). Within the usability tests of this thesis, test user 1 and test user 2 (see *Table 7*) can be considered expert users. These users are familiar with fields like web

engineering, usability engineering, interface and interaction design. Thus, usability tests with these test users are aimed at reflecting on the coded prototype for "posts" not only from the view of a potential user but also from the view of experts in this field.

The usability tests carried out within this research are based on the theories and methodologies of *exploratory tests* and *assessment tests*. Exploratory tests, also referred to as formative tests, are conducted in early development cycles to examine the effectiveness of preliminary design concepts (Rubin & Chisnell, 2008, p. 29) as part of the iterative design process (Nielsen, 1993, p. 170). Assessment tests, also referred to as summative tests, on the contrary, are considered the most typical type of usability test conducted in early or midway development cycles to examine how effectively specific concepts have been implemented based on performance of realistic tasks (Rubin & Chisnell, 2008, p. 34-35). Such tasks as well as goals, respective evaluation methods and the setup of the usability tests are defined within the *Test Plan*[1].

Within this research, the test users are provided with a list of test tasks that need to be performed using the coded prototype for "posts". To provide a rather realistic context, the coded prototype was integrated within the current version (at the time of end of this research) of Portfolio 3.0 and filled with exemplary content and users. The test users were asked to comply with the "Thinking Aloud" principle verbalizing their thoughts and thus enabling the test moderator (the author of this thesis) to understand the user's view on the interface and his/hers misconceptions (Nielsen, 1993, p. 195). Rubin & Chisnell (2008, p. 204) describe the "Thinking Aloud" principle, when done well, as a technique that assists to "read their minds" (the user's mind, respectively). As a consequence, the test users were asked to think aloud and to perform the test tasks autonomously without any help by the moderator of the test (the author of this thesis). However, the author of this thesis is free to intervene during test tasks providing hints or tips if regarded as necessary, even though primarily serving as an observer.

Additionally, performance of the test tasks by the test users was recorded whereas the screen of the test computer was captured, the test user was filmed by the computer's webcam and the audio protocol was recorded. Using these three recordings a video-in-

[1] See http://eu.wiley.com/WileyCDA/WileyTitle/productCd-0470185481,descCd-DOWNLOAD.html for further resources on the subject of Usability Tests and Test Plans.

video was automatically generated and compiled for purposes of debriefing and reconstruction of the usability tests. This method of replaying the test, also referred to as *retrospective review*, is an excellent technique for the test moderator as well as for the test user to remember important points of the tests (Rubin & Chisnell, 2008, p. 235). Furthermore, by providing a video-in-video, specific scenarios of the tests can be reconstructed in reference to the user's actions on the screen and his/her facial expression.

In the following some insights into the observations and debriefings of the usability tests are discussed. The author of this thesis aims at stating that the test users have neither seen the coded prototype for "posts" nor worked with a version of the Portfolio project before. Hence, the prototype integrated in Portfolio 3.0 was largely regarded as a new type of communication system for courses by the test users and as a consequence, some of the concepts were regarded as unfamiliar heretofore. Furthermore, the author of this thesis wants to state that the following discussion does not include every detailed aspect of the usability tests and the respective observations. Minor details not considered relevant for the evaluation within this research are not addressed.

Nevertheless, the observations and debriefings within the usability tests clearly indicate that, to a great extent, concepts and principles of the coded prototype for "posts" are perceived as self-explanatory and easy to learn by the test users. This is because lots of concepts such as voting, posting or replying are familiar from other contexts such as Social Networks or other web applications. Thus, these concepts are conceptually associated with prior experiences with other systems by the users, even though implemented in a varying way within the coded prototype for "posts". Furthermore, the test users easily identified the meaning of icons such as posting, replying, favoring (or saving/bookmarking, respectively) and voting as well as other interface concepts such as tabs, buttons and tags. Usage of tags for categorization and filtering of posts with the possibility to flag posts with multiple tags was recognized correctly and subjectively conceived as valuable.

Regarding voting, most test users would have preferred "thumbs up"- and "thumbs down"-icons instead of the upturned and downturned arrows as thumbs are rather perceived as indicators for actions such as voting or liking, according to the test users. One of the test users misconceived the upturned and downturned arrows as an interface element for sorting posts. In addition to that, some test users stated that they would have expected

the interface elements for voting to be displayed more prominently and/or inside the box (regarding replies) where elements like avatar, nickname and the actual content are placed. Moreover, some of the users were confused about the number being displayed between the upturned and downturned arrows. Whereas some of the test users got the concept right and stated that the number might indicate the average value of votes (as these users saw the number of up-votes and down-votes as a tooltip of the actual number), other users assumed the number to be the number of up-votes. An alternative approach to this concept would be to display both, the numbers of up-votes and down-votes, right away instead of the average value.

Regarding concepts and principles that were not interpreted right at the first attempt, it is safe to say that the test users have no problems learning them easily and recognizing utility and significance of such concepts. For example, different background colors for different types of users remained unknown until first confronted with the respective meaning. As soon as the test users concerned themselves with specific interface elements, they recognized the meaning and utility of those by themselves. However, most of the test users would have preferred tooltips and further support by the system in some scenarios. In addition to that, some of the test users would also prefer important concepts such as filtering or replying to be displayed more prominently. One of the test users stated that he would have expected the text box for replying right away and below the already existing replies (instead of above them and fading in after clicking).

All of the test users were confronted with the concepts and principles of the coded prototype for “posts” at first in the scope of the news feed and could later easily apply these concepts and principles as well as the obtained knowledge of the prototype to other parts of the system. Thus, test tasks also concerning context- and content-related communication within the scope of challenges (or assignments, respectively) or course slides were conducted smoothly by the test users. Most of the test users explicitly stated that they subjectively liked the idea of a unified approach to communication within the frame of Portfolio 3.0 and the coded prototype for “posts”.

The author of this thesis wants to add that irrespective of differences in attitudes, preferences and experiences of the test users, all of them managed to carry out the given test tasks equally well. It was particularly interesting to observe that the test users with least experience in computers (test user 3 and test user 4) were in no way inferior to the

other test users. On the contrary, both test users perceived specific concepts and principles of the prototype more easily and quickly than the expert users (test user 1 and test user 2). This might be because of varying reasons. Test user 3 and test user 4 might notably have considerable talent for perceiving concepts and principles when the context of the application is known or in associating with already familiar concepts from Social Networks. Furthermore, it might be that the expert users observed the prototype from a "too technical" point of view aggravating these users to conceive concepts and principles from a simplistic point of view. Within the debriefings of the usability tests the test users were asked to assess some statements regarding the coded prototype for "posts" using grades. This assessment is intended to further reflect on personal thoughts and opinions of the test users and relates only to the coded prototype for "posts" but not to the Porfolio 3.0 system in its entirety. The respective grades that were available for assessment are: 1 = fully correct; 2 = rather correct; 3 = neither correct nor incorrect; 4 = rather not correct; 5 = not correct at all. The assessment of the statements with their maximum and minimum grades as well as the mean grades is summarized in *Table 8*.

Statement	Min	Max	Mean
I could conduct the test tasks uncomplicatedly.	2	2	2
I could conduct the test tasks quickly.	1	3	1.5
I could conduct the test tasks easily.	1	3	1.67
I could conduct the test tasks at the first attempt.	2	2	2
I oriented myself immediately within the system.	1	3	2
I think the system is clearly structured.	1	4	2.5
I think the system is easy to use.	1	3	2
I think that communication concepts in the system are better, more efficient and easier to use than in other systems used in Higher Education.	1	5	2.67
The system was using interface elements I was not expecting.	1	4	2.17
The system was lacking in interface elements I was expecting.	2	4	3.5
I was not clear about the utility of some interface elements.	2	4	3.5
I was not clear about the functionality of some interface elements.	2	5	3.67
The system was operating stably.	1	3	1.83

Table 8. Assessment of statements regarding the coded prototype for "posts".

7 Conclusion

Designing and integrating proper concepts within the context of course-related communication is considered an omnipresent problem in Higher Education. Irrespective of different attitudes and preferences regarding the utilization of online systems to support course-related communication and activities, as discussed in Chapter 6.1, the trend is towards web-based solutions to accommodate needs and requirements of constantly growing numbers of participants of courses in Higher Education. This trend can contemporary be observed with the wave of MOOCs, as discussed in Chapter 3.3.

As course-related activities and resources such as assignments, quizzes, lecture streams and course material are also getting more and more shifted towards online supporting systems of courses, design and integration of communication concepts beyond the scope of common discussion forums is considered indispensable in order to provide possibilities for course-related communication that are effective and easy to use. Hence, a unified approach for course-related communication in terms of usability, interface and interaction design is essential.

The design, implementation and evaluation of the prototype within this thesis can be regarded as an initial approach towards a unified solution for course-related communication. As the evaluation of the prototype reveals, test users managed to successfully carry out given test tasks that are related to possible real-life scenarios within the scope of Higher Education. The test users largely assessed the prototype as easy to use and were subjectively satisfied with the integrated concepts and principles regarding usability, interface and interaction design. The integration of varying usability concepts derived from Social Networks and Web 2.0 applications such as Web-based Q&A systems was evaluated in a particularly valuable way.

The results and outcomes of this thesis therefore conclude that contemporary and new communication concepts as those integrated into the prototype designed, implemented and evaluated within the context of this research do have positive effects on user

experience and user satisfaction, even though the respective prototype has to be considered an initial approach towards a unified solution for course-related communication. As evaluation of the prototype shows there are several aspects that need to be reconsidered and further integrated.

Furthermore, the author of this thesis wants to state that the results of this research go beyond the scope of a single prototype that might be integrated into course- or learning management systems. This thesis rather indicates concepts, principles, design and usability guidelines that might be also considered relevant beyond the scope of the respective prototype and the Portfolio 3.0 project. With theoretical investigation on one hand and exploratory research methods on the other hand, this thesis shows how theory and practice may overlap in reality and thus providing research by design to be a valuable method to design, develop and evaluate systems within the context of human computer interaction.

8 Outlook

As this thesis can be regarded as prior and initial research towards a unified solution for course-related communication there are a lot of aspects that need to be further investigated and/or practically integrated.

As discussed in Chapter 5 and Chapter 6 there are concepts and principles that are on one hand not yet integrated into the coded prototype for “posts” and on the other hand need to be reconsidered in terms of usability, interface and interaction design. One of the points that need to be addressed in further research are the concepts and interface elements for votes, as already discussed in the previous chapters. This regards the selection of proper interface elements for voting as well as visualization of numbers and values concerning votes. As a consequence thereof modeling of specific ranking algorithms for “hot” posts considering number of votes, date of posts and number of replies is also regarded as a requirement for effective ranking and sorting of posts whereas for posts with a large number of replies nonrelevant posts should be faded out per default.

In addition to that, further “intelligent” filters need to be integrated that are able to filter unresolved, unanswered or unread questions, as examples. As ranking for posts should be improved, also ranking and sorting for comments should be integrated (i.e. ranking comments by date, number of votes or flags assigned by administrators). One major aspect that is not included within the coded prototype for “posts” is the possibility for private posts. The current version of the prototype at the time of the end of this research does only include public posts whereas private posts (e.g. direct messages, group conversations, staff feedback to private activities) are considered essential within the scope of course-related communication.

Furthermore, the coded prototype needs to be better integrated into Porfolio 3.0. As several aspects of Porfolio 3.0 might be adapted in the future, also aspects of the coded prototype for “posts” would require adaption, accordingly. Even though evaluation within this thesis provided adequate results, the application of the coded prototype for “posts” or

Portfolio 3.0, respectively, within real courses at Vienna University of Technology would provide feedback and insights which produce a higher level of quality. Thus, the prototype and system could be tested in a natural environment more probably encountering unexpected results and problems. Moreover, the system could be evaluated whether it is able to meet the needs of a large-scale audience alongside side effects such as a high number of posts, replies, server requests and site hits.

Figures

Tables

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