

Discuss. New Designs for Asynchronous Online Discussion for E-Learning in Higher Education

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Wien, 13. 8. 2011

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Kurzfassung

Diskussion und Argumentation im Lehrveranstaltungskontext sind in allen akademischen Disziplinen essentiell. Im Rahmen dieser Arbeit wurde spezifisch für den Einsatz mit dem bestehenden E-Learning Framework am Institut für Gestaltungs- und Wirkungsforschung der TU Wien (HCI group) ein asynchrones Online-Diskussionssystem namens *discuss* entwickelt, in dem die Qualität der Partizipation, die Höhe des Lernertrags und die benutzerfreundliche Handhabung im Vordergrund stehen.

Die Hypothese ist, dass Verbesserungen an Diskussionssystemen im E-Learning-Kontext gegenüber etablierten Designs durch Veränderungen der visuellen Struktur und der Interaktionsmuster möglich sind. Im Rahmen der Diplomarbeit wurde ein Repertoire an Designstrategien erarbeitet und in Zusammenhang mit dem Designprozess des zu entwickelnden Systems gestellt.

Der vorliegende Text gibt einerseits die Verknüpfung sozialwissenschaftlicher Grundlagen, Studien und Analysen bestehender Systemen wieder. Andererseits werden Konsequenzen für das Design gezogen und der Entwicklungsprozess des neuen Systems geschildert. Schließlich wird das System im Lichte der erarbeiteten Prinzipien evaluiert.

Abstract

Discussion and argumentation in the context of learning is essential in all academic disciplines. In the course of this project, an asynchronous online discussion platform named *discuss* was developed specifically for the context of the existing e-learning framework at the Department of Design & Assessment of Technology (HCI group) at Vienna University of Technology. The objective was to maximise quality of participation, learning outcome and usability.

The hypothesis is that it is possible to improve discussion systems in e-learning by changing the visual structure and the patterns of interaction. To this end, a repertoire of design strategies was developed and related to the design process of the new system.

In this text, theoretical foundations and studies are connected to an analysis of existing systems. From this, design principles for the new system are derived, and the development process is documented. Finally, the system is evaluated in terms of the acquired principles.

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1 Introduction

The Internet is a communication medium. Its revolutionary power lies in the fact that it allows every consumer to also publish a variety of content across any distance and to any number of recipients, at hardly any additional cost. Most internet innovations that have truly changed everyday life are new forms of community interaction and collaboration: *eBay*, *Wikipedia*, *facebook*, *twitter*.

There is a mode of group communication on the internet that has been there from the very start and has, in its basic character, changed very little over time: *Asynchronous Online Discussion* is the communication model of e-mail lists, newsgroups and bulletin board systems, but the structure of these old internet services has survived virtually unchanged into “wall” discussions on *facebook*, comment sections on blogs and restaurant review sites.

This thesis investigates the characteristics of Asynchronous Online Discussion systems in the context of the task to design such a system for an evolving custom e-learning solution at the Human Computer Interaction (HCI) working group of the Department of Design and Assessment of Technology at Vienna University of Technology. The central question is: If we design a discussion platform for educational purposes today, can we improve upon the existing models that are used in the contexts mentioned above, and if yes, how?

Under guidance of and in collaboration with Prof. Peter Purgathofer (of the HCI group) I designed and developed such a system named *discuss* that was used for lectures in the winter semester 2010/11 and integrated into the larger e-learning framework. On the following pages, the research and theory relevant for the design decisions is discussed, and the process of design, testing, use and evaluation is detailed. The system I developed currently serves as the discussion component of the department’s e-learning tools; this document paper is a written accompaniment to this system.

1.1 A New Platform

A forum is typically treated as an add-on, the addition of a ready-made system to a website or a web-service. But since the HCI department enforces innovation in their own teaching tools,

the plan to replace the limited existing discussion module was an opportunity to move beyond a traditional bulletin board system.

To discover potential improvements that could be included in a new discussion platform, however, it was necessary to investigate existing Asynchronous Online Discussion (AOD) systems, to retain their essential characteristics and to address the specific weaknesses of their various approaches.

The success of the new system would be measured by the resulting discussions, and if the participants took away new knowledge or a new aspect of a problem. In an educational context, a learning outcome for the participants is the most important goal; this does not apply to many other AOD systems on the internet, many of which serve the primary purpose of creating a vibrant community. This does not mean that learning does not take place in non-educational contexts - quite the contrary! In my research all theories and existing systems presented are investigated with particular attention to the potential to support learning.

The overarching goal was not to reinvent the “wheel” of AOD, but to synthesise the best qualities of a variety of ideas from various application contexts to the best solution for productive discussion in the given e-learning context, and to consciously contribute to the gradual evolution of AOD systems with a design which can be justified by and related to extensive research and analysis.

1.2 Overview

The following text is divided into eight chapters.

In chapter two, essential knowledge about computer-mediated written communication is reviewed.

In chapter three, the connection between discussion and learning is investigated: Communication is not pure transmission of factual knowledge, but can be used to synthesise new knowledge.

Chapter four is a brief discussion of e-learning and how to integrate discussion-based knowledge synthesis into internet-based learning tools in a way appropriate for the available technology and the current patterns of media use.

In chapter five, existing AOD systems are compared and analysed, and common design strategies are extracted.

Chapter six is a complete description of the context for which the discussion platform was developed, its features and technical specifics, and an account of the design & development process.

In chapter seven, the system is evaluated, primarily by an analysis of the texts produced.

Chapters eight and nine provide a conclusion and a prospect of potential changes and future work.

1.3 Methodology & Character of Work

This paper is intended as both a theoretical investigation of a certain mode of communication, and as a design document that accounts for the shape the system took.

1.3.1 Scientific Principles

The theory section is based on a variety of sources from the social sciences. The analysis of examples features a selection of AOD systems that I have found interesting and relevant, and is by no means representative or exhaustive.

Evaluation is an important part of the design process, and its purpose in this context is to realise where the strengths and weaknesses of certain design strategies lie. The focus lay on rapid, iterative, qualitative evaluation throughout the design process, and on a general measure of the success of the system in its service during the winter semester 2010/11. I make no claim to an evaluation that can provide statistically sound data for an objective comparison to other AOD systems.

1.3.2 Extent of Practical Work

While chapter six gives an account of the design and development process, it is important that the reader can judge the character and extent of my work, and the relation of theory and practice in the development process.

Prof. Purgathofer initiated the design and development of the new discussion platform. My practical work consisted of an iterative process in which I participated in design meetings with Purgathofer (and sometimes other people involved in the development and maintenance of the e-learning system) and, following the meetings, implemented prototypes that would incorporate the changes on which we had agreed. Therefore, all current features of *discuss* are the result of this collaborative design process. The program code of *discuss* is my work, except for parts derived from some of the other modules that are part of the e-learning framework. The development took place in June/July/August 2010. During the winter semester (September 2010 – January 2011) I provided maintenance and bugfixing. In February/March 2011, I proceeded with the further integration of *discuss*.

1.3.3 Relation of Theory and Practice

During and after the design and development, I put the design principles eminent in *discuss* in context by relating them to the research detailed in chapters 2-5. This research did not happen collaboratively and was never consciously introduced into the design meetings and reviews. It should provide a frame and measure for the practical work. By and large, theory did not explicitly motivate practical decisions – but the practical decisions can be better understood and judged by addressing all relevant theory and analysis.

There is another way to look at it: Design is not necessarily the result of research – it can be a method of research. The design of *discuss* was a process of research that overlapped with other kinds of research. The different processes (or modes of research) are addressed in separate chapters: A review of theory and studies (chapters 2-4), empirical analysis by example (chapter 5), design (chapter 6), design evaluation (chapter 7).

1.4 Conventions and notes

Since the term *Asynchronous Online Discussion* is central to this thesis but somewhat unwieldy, it is abbreviated as *AOD* throughout the document, following the convention in related research literature. Likewise, *Computer-mediated Communication* is abbreviated as *CMC*.

In some cases, Wikipedia is cited. Clearly, Wikipedia is edited by an open community and therefore lacks the level of integrity peer-reviewed scientific publications provide. Whenever Wikipedia is given as a reference, the reader may be assured that it was chosen for giving certain definitions in a better-articulated or more condensed way than other sources accessible to me, and that the referenced article provides citations of more reliable sources.

2 Web-based Communication

2.1 Communication

Before the forms of web-mediated communication are discussed, a few definitions and distinctions of forms and conditions of communication shall be introduced.

Communication is defined by Burkart (2002, pp. 32f) as a form of social interaction: Individuals perform actions directed to each other with the intention to share meaning. The process is only to be called communication if it is reciprocal, i.e. if the participants react to each others' acts of meaning-transmission with their own acts. "Symbolic Interactionism" states that humans live in a symbolic environment, that they base their actions on the meanings the things in their environment have for them and that the meanings are changed by communication. Successful sharing of meaning depends on a coordination of social actions and a negotiation of perspectives and shared "significant" symbols in the participants' different symbolic environments. (Burkart 2002, pp. 432ff)

Jürgen Habermas' *Theory of Communicative Competency* further postulates that every person who performs communicative acts knows (implicitly) that a number of universal claims are made by such an act: *Intelligibility*, the claim that the messages are understandable by the recipients in terms of the symbolic system used; *Truth*, the claim that the subject of the communication is something that has a relation to the perceived reality of the recipient; *Truthfulness*, the claim that the intention of communication is the one perceived by the recipient; *Correctness*, the claim that the messages are appropriate for the institutional and situative context so that meaning can be shared. (ibid., pp. 437ff)

While the success of a communicative act primarily consists in conveying meaning, Schulz v. Thun characterised every message as four-sided: Besides the *objective content*, there is also a *relationship layer* codifying the participants' relationship as seen by the sender, a *self-revelation layer* communicating personal characteristics and emotions of the sender, and an *appellation layer*, the desired change in behaviour that the sender wants to see in the receiver. (ibid., pp. 126f)

These distinctions are useful when intentions to communicate or possible misunderstandings related to the conditions of a certain medium are investigated.

2.2 The internet as a communication medium?

Communication is always mediated. A useful distinction between “grades” of media is that between *primary media* (language, body language etc.), *secondary media* (which require a technical appliance on the side of the sender) and *tertiary media* (which require technical appliances on the side of the sender and on the side of the receiver). Since the internet has become a service that combines different other media and makes roles such as sender, receiver and publisher interchangeable, the term *quartary media* has begun to appear, specifically designating computer technology. (Burkart 2002, pp. 36ff) This definition seems to fit within the third category, but was apparently coined to honour the fundamental differences that multimedial content and networked computers introduce.

(Beck 2006, pp. 12f), in a different definition, claims that the typical requirements for a “medium” are *transmission technologies*, *symbolic systems*, *social institutions* and *organisation*. A medium of the *first order* designates the technical infrastructure for the transmission of data that recipients can interpret; a medium of the *second order* is a system of socio-cultural institutions. Trying to place the internet in this scheme, Beck comes to the conclusion that the internet *as a medium* cannot be clearly associated with any of these categories, but the network as such may be regarded as a medium of the first order, while the services used via the internet can form media of the second order, but each with its own set of characteristics.

2.3 Types of internet media

In their early analysis of “The Internet As Mass Medium”, Morris & Ogan (1996) attempt to categorise types of communication that occur in internet-enabled media. While their categories do not seem entirely applicable fourteen years later (or indeed at any time), the basic parameters that they use are helpful: The quantitative sender-receiver relation and the synchronicity.

The synchronicity parameter describes the time dimension of the communication process. Participants engaged in synchronous communication are directly involved in the discussion at the same time, as they would be in a face-to-face conversation. Involvement, in online communications, means paying at least partial attention to the conversation, such as having a chat-window or a *Skype*-videofeed opened and active. Asynchronous communication, conversely,

means that the participants are, in general, not actively or passively participating in the conversation at the same time. An example is e-mail, where messages are generally not checked or answered immediately upon receipt.

Obviously, the distinctions between these categories are blurry. Instant Messaging (such as *Google Talk*, *jabber*, *AIM*, *ICQ*, *MSN*), at least from personal experience, generally takes the character of relatively synchronous conversations, with possible gaps depending on, among other things, the relationship to the communication partner; additionally, many IM applications (such as *Adium*) display older conversations in the same window as the current one and thereby show one feature of asynchronous communication, the archiving of contributions. “Shout boxes”, on the other hand, often add something like a chat-channel to an otherwise asynchronous forum. *Google Wave* was a recent attempt to completely bridge the two extremes by providing a persistent, real-time hybrid of group chat, e-mail discussion and media-sharing platform. It was, however, abandoned, presumably due to poor take-up.

Morris and Ogan’s other parameter describes the number of senders and the number of receivers. In the traditional mass media (television, radio, newspaper) an entity “broadcasts” to a more or less large audience (one-to-many) while in direct correspondence (mail, telephone) the relationship is one-to-one. A many-to-many relation outside a face-to-face discussion used to be limited to telephone conferences. While the boundaries are not sharp and this classification of media according to the numbers of senders and recipients is problematic for various reasons¹, it is apparent that the internet encompasses media with differences in this parameter: The “classical” model of a website is closest to a one-to-many distribution, instant messaging is most commonly used for one-to-one conversations and mailing lists are of a many-to-many type in that they allow every participant to post messages to the total “audience” of the list.

One of the radical changes the internet has brought about is the multitude of possibilities for the one-to-many type of communication, at no (or a low) price except for what one already pays for a computer with internet access. This reduction of publishing cost is what truly changed the media landscape. Clay Shirky writes: “It used to be hard to move words, images, and sounds from creator to consumer [...]. In return for helping overcome these problems, media businesses got to exert considerable control over the media and extract considerable revenues from the public.” (Shirky 2008, p. 59) Now that the scarcity of the resource of communication channels is

¹ see Beck 2006, pp. 22ff

gone, everybody can publish, rendering the definition one-to-many somewhat inaccurate. One consequence is that there is an abundance of information that is published without the quality control connected to the cost and structure of traditional mass media, requiring new techniques and skills of filtering relevant from irrelevant information.

The majority of internet users, though, probably do not “publish” information with a sort of general audience in mind (although, through the convergence of blogs, twitter, and facebook, this is another distinction that has become problematic), but participate in one-to-one or many-to-many communication. What is the qualitative difference, if any? Media philosopher Vilém Flusser makes a distinction between *discursive* and *dialogic* media:

In discourse, information is contained in the memory of the sender and transmitted to the memory of the receiver. Therefore, information precedes the discourse, and discourse serves the purpose of transmitting information from one participant to another participant of a culture. An example of this is a lecture. In dialogue, there is partial information in the memories of the participants that is being synthesized into global information by the process. Therefore, new information results from dialogue, and it serves the purpose of elaborating information for a culture. An example of this is parliamentary debate that elaborates a law.

(Flusser 2002, p. 18)

The intention of “publishing” as the one in a one-to-many mode, then, is to transmit information, with possible exceptions of a reduced channel for transmission in the other direction (traditionally, letters to the editor of a newspaper or questions from students in a lecture). Even if such a channel exists, the recipients are not connected to each other (Flusser 1997, p. 148), at least in the traditional mass media, which should therefore rather be characterised as “one-to-many-ones”; this condition is changing through the attachment of communication platforms to web versions of “broadcast” media such as online versions of newspapers.

The intention of entering a dialogic discourse, on the other hand, is to participate in the generation of new meaning. Prime examples of this type that predate the rise of the internet are the informal discussion among friends, the corporate meeting, the academic seminar and the plenary session. Now, such discussions can also take place over mailing-lists, internet forums and video conferences.

Web-based discussion forums, mailing lists and sections of websites that allow the users to leave comments are, in any given context, clearly a form of dialogic communication, at least in terms of intention. All participants are potentially both senders and recipients of messages (many-to-many), and the purpose of communication is, in most cases, not the dissemination of meaning, but its generation and transformation. The communication they allow is usually rather asynchronous, hence they are generally referred to as *Asynchronous Online Discussion* (or just AOD) systems in research literature.

2.4 Characteristics of internet-mediated written communication

AOD systems have a number of characteristics that they (partly) share with more synchronous computer-mediated communication such as various chat systems:

Most significantly, all communication is (by and large) constrained to the written word. In many-to-many communication, in which different participants contribute different facts, opinions, hypotheses, questions and feelings, the lack of contextual cues (body language, tone of voice etc.) creates a big difference to the way a discussion would be held in a face-to-face context - Sabina Misoch speaks of “disembodiment” (Misoch 2006, p. 56), a term widely used to indicate the separation of one’s own body from the (communicative) actions.

While forms of asynchronous communication similar to new web-mediated ones have existed for a long time as “open letters” in a newspaper, for example, the specifics of the “central” medium (newspaper) and the limits in style (letter), time (previous issue) and space (only some letters are selected) prevented the development of a different type of text. On the internet, however, a number of patterns have emerged to compensate for the absence of nonverbal communication and the writing style tends to be adapted to fit the specific context of the discussion platform.

2.4.1 Compensation of nonverbal communication and *backchannels*

The most obvious example of the re-introduction of nonverbal communication is the emoticon². With reduced forms (originally ASCII-characters, now often more or less minimally

² probably “invented” by Scott Fahlmann in a newsgroup in 1980 (see Beck 2006, p. 89)

designed little pictures), the message is enriched by “metacommunicative” (Beck 2006, p. 90) additions, for example, to mark something as ironic or to communicate the mood of the author without verbalising it (which appears natural to us since in a face-to-face conversation, we usually communicate our emotions via body language and tone, consciously or not). The word “emoticon” is a contraction of “emotion” and “icon” - an *icon*, in the semiotic sense, is a sign that “due to some similarity, due to inner characteristics, which correspond to characteristics of the object in some way, points to the designated object.” (Eco 1977, p. 60, my translation, P.H.) Though Eco adopted this definition from C. S. Peirce and highlights its problems, it is valuable since it distinguishes the icon from the *symbol* which is arbitrary, i.e. there is generally no perceptible connection of its form to its signified meaning. The *iconic* character of emoticons, then, is essential as they point to (mostly) facial expressions without describing them, which would entail a reduction of ambiguity to what the construction of word-symbols could allow. Paradoxically, the construction of these icons themselves is founded on some form of convention.

Another pattern to achieve a similar effect is the use of sound and action words, such as “hmm”, “*gasp*” or excessive punctuation (“!!?”). Beck (2006, p. 92) suspects that this is derived from similar patterns in comic books and was introduced to online communication by a young audience with an affinity to pop culture. While some such utterances may be onomatopoeic, and hence iconic, they are verbalised, but still represent actions of (mostly) non-verbal communication.

Why are utterances such as “hmm” needed? After all, we do not need them in letters, a long-established form of written communication. The context in which they appear is that of chat or instant messaging, where synchronicity is high and responses are expected almost as quickly as in a face-to-face discussion. Consider the following example, given by Dix et al. (2003, p. 479):

Alison: Do you fancy that film... er... ‘The Green’ *um*... it starts at eight.

Brian: Great!

During the first ellipsis (“... er...”), Alison looks at Brian, who has a quizzical look on his face. Realising that he doesn’t know what she means by ‘that film’, she expands to “‘The Green’ *um*...”. As she says “*um*...”, she looks at Brian again and now he nods, or makes a “mhm”, to signal that he now knows what film she is talking about. She was prepared to elaborate further, but as Brian now knows what she is referring to there is no need for that, so she continues with arranging the date.

Dix et al. call these mimics, gestures and noises Brian made *backchannels*; without these, Alison would have had no idea whether Brian was following her and probably would have had to explain everything in greater detail, just to be sure. Such backchannels are missing in AOD (because the recipient is probably not present when the speaker is “saying” something) and are only simulated in more synchronous discussion. A “hmm” in an instant messaging session would signal that the other is listening and thinking, an “mhm” would indicate that the other has understood or acknowledges what has been said. In face-to-face discussions, backchannels are also used to facilitate turn-taking: A “well uh” might be short enough not to interrupt a speaker, but noticeable enough to signal that the one who uttered it wants to say something and should be given opportunity to do so soon. (Dix et al. 2003, p. 480) Turn-taking, however, is more problematic in a near-synchronous system than in AOD.

Backchannels are compensated for most in synchronous online communication, since the synchronicity invites messages that are closer to transcribed speech than to articulated writing. The messages are shorter and the presence of the conversation partner can make communication more efficient through more rapid responses. Increased pace and shorter messages can be made even more efficient if backchannels can be simulated through the means described.

2.4.2 Style and jargon

Beck (2006, pp. 91ff) also suggests that e-mail communication (the subject of his investigation, but I would argue that the point is also applicable to forums) constitutes a new type of text. The style of the text is typically informal and the authors sometimes do not even try to follow established orthography, grammar and punctuation; the recipients often do not expect it, either, as long as intelligibility does not suffer. E-mails can range from substitute letters complete with formal address to short notes akin to mobile phone text messages; forum conversations can range from argumentation fit for academic papers to rapid informal conversation.

Often, such texts exhibit a style that is more commonly associated with oral expression. Beck (ibid. p.93) points to a distinction between “conceptional” and “medial” oral and written expression. “Medial” describes the manifestation of the text and “conceptional” describes what style and norms characterise the text. A transcribed interview is conceptionally oral, but medially

written; a recitation of a law has the opposite combination. In e-mails and forums, the messages are often somewhere in between (if oral and written expression can be understood as extremes of a continuum).³ Conceptionally oral form may also serve as a way to support the (subconscious) mental image of a face-to-face discussion and thereby strengthen the effect of the nonverbal communication patterns mentioned above.

Every group that communicates about specific topics will develop a jargon of some sort, even if it is minimal. The definition of jargon from the *Encyclopedia of Language and Linguistics*:

“This article sees jargon [...] as the language peculiar to a trade, profession, or other group; the language used in a body of spoken or written texts dealing with a circumscribed domain in which speakers share a common specialized vocabulary, habits of word usage, and forms of expression. [...] Jargon has two functions: to serve as a technical or specialist language; and to promote in-group solidarity, excluding as out-groupers those people who do not use the jargon. Everyone uses jargon, and most people use more than one type.”

(Allan 2006)

A jargon that is “pandemic”, so to say, used by a significant proportion of the more informal web-forums and mailing lists, is a set of acronyms that serve nonverbal communication compensation (“LOL” for “laughing out loud”), act as disclaimers (“IMHO” for “in my humble opinion”) or structure and clarify the conversation (“RE” for “regarding”; “@Name” for “reply directed to Name”). The prevalence of such abbreviations underlines that fast and efficient communication is often the primary concern in online group conversations, although it may also be a way of “promoting in-group solidarity” among the (then) subculture that populated online forums in their early phases.

It should be noted, however, that the use of jargon and acronyms varies greatly. In a student mailing list I participate in, the abovementioned acronyms are common, alongside computer technology jargon and a large number of inside-jokes and expressions. Other mailing lists, however, have a more formal style, and in a study of a mailing list on the topic of “evaluation”, Thilloren (2007) finds that the participants (academics, students, but also many professionals) use a style almost comparable to academic papers, addresses are similar to those used in letters,

³ It is important to note that oral expression, here, especially if never spoken but written down by its own author, can in no way be likened to the “orality” of illiterates, as Walter Ong discusses extensively in “Orality and Literacy” (Ong 2002).

and apart from subject-specific terms and the occasional abbreviation of the most commonly used terms, there is no particular jargon that would “promote in-group solidarity”.

2.4.3 Frequency and type of participation

In the same study, the author published some quantitative data on the “evaluation” mailing list they observed. It is also mentioned that about half of the threads remained without a public answer. With this in mind, it becomes apparent that both variables *mails sent per person* and *thread length* follow a power law distribution, more specifically a *Zipfian* distribution. *Zipf's Law* originally states that “given some corpus of natural language utterances, the frequency of any word is inversely proportional to its rank in the frequency table. Thus the most frequent word will occur approximately twice as often as the second most frequent word, which occurs twice as often as the fourth most frequent word, etc.”⁴ If k is the rank of an element, s the exponent and N the number of elements, the frequency function of the element is

$$f(k; s, N) = \frac{1/k^s}{\sum_{n=1}^N (1/n^s)}.$$

Fig. 1: Zipf's law.

The shape of power law functions (see Fig. 2) not only applies to natural language, but also to various ranked distributions in social systems, as Clay Shirky (2008, p. 124) observes: “The general form of a power law distribution appears in social settings when some set of items - users, pictures, tags - is ranked by frequency of occurrence.” What he calls a power law distribution is, again, more specifically Zipfian. Another way to look at it is to say that 20 percent of the ranked items account for 80 percent of the probability mass and vice versa (ibid., p. 125).

⁴ Wikipedia: http://en.wikipedia.org/wiki/Zipf%27s_law

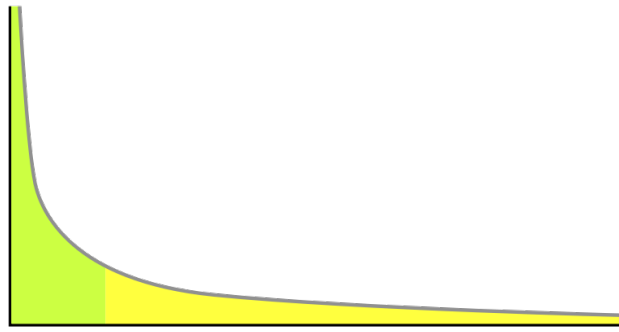


Fig. 2: Power law distribution. 80% of the mass lies on 20% of the x-axis.

The fact that the mails/person data follows a Zipfian distribution leads to the conclusion that there is a “core” of very active posters and a “long tail” of occasional posters, probably with a good number of “lurkers” (persons who only read and do not post). This is observable in most open web-forums, on many mailing-lists and in different contexts such as Wikipedia (ibid.). This might be due to personal social behaviour: Amon (2004), studying a youth web forum on video games, observes one poster who rarely writes anything, but when he does, the posts are long, thought-through and polished; he even states that he spends a great deal of time on every single message he writes. Other participants, in comparison, write shorter and less revised messages. Another factor is certainly the personal engagement with the platform as a whole, the “community” and the predominating topics.

How does this distribution fall into place? Beck (2006, p. 100) suggests a distinction between “centre” and “periphery” of a mailing-list: In the periphery, there are the aforementioned lurkers; the “posters”, who contribute, but do not “instigate identity” as many of their posts are self-representation or announcements; the “discussants” who participate actively in topical discussions, but limited in time and scope. The “core”, on the other hand, is “socially integrative” and often consists of the founders, who also perform administrative and metacommunicative tasks.

A Zipf-like distribution, however, also applies to thread length, at least in Thillosen’s study. The longer threads, the author says, are on general or technical topics (Thillosen 2007, p. 172), the shorter ones on more specific topics. A large number of “threads” are degenerate in that they do not get any replies at all; many of them, however, are introductions or announcements.

2.4.4 Anonymity, Authenticity, Identity

Participation patterns are also closely tied to the way one's identity is represented online.

While every computing device connected to the internet is uniquely identifiable by an IP address, the grade of practical anonymity varies. Most web-based forums offer the possibility to choose an arbitrary nickname for one's own online identity and to display various other personal data to other users. Amon (2004, p. 76) uses the definition of identity as a combination of a person's awareness of being different from others (individuality) and of staying the same person throughout time (continuity) and different situations (consistency), characterised by certain attributes. Given that one has an idea of one's identity in "real life", one can attempt to design one's online identity either as completely congruent, as generally different or as "quasi-authentic" (Beck 2006, p. 130), the latter involving an exaggeration of certain (desirable) own characteristics and an exclusion of others. Beck cites an enquête in which participants of an online chat judge the relative majority of their participants as being "quasi-authentic" and suggests that that group of people tends to feel "misunderstood" in their "real" identities. It is questionable whether these numbers have great significance or whether they apply to other online media as well, but it is not unreasonable to assume that if a user "designs" any sort of identity online, it will most likely be "quasi-authentic": "[M]ore expressions of self are 'given' rather than 'given off' in an online context (Ellison et al. 2006), i.e. the deliberately constructed expressions of one's own identity outweigh the involuntarily published ones. This is because "the mediated nature of [online social networks] means that most information about the virtual self and its place in the network is given through deliberate construction of signs." (Pearson 2009)

The best example for this is the social networking platform *MySpace* on which many participants create an online identity that might bear their real name or not and that highlights their individual traits, as perceived by themselves and as seen by themselves as worthy to publish to a more or less general audience. It is significant that, in contrast to anonymous chat rooms, social networking sites are based on the general assumption that the users' online identities are representations of their "real" identities, discouraging "identity play". The "disembodiment" is reduced and authenticity is expected. Sessions (2009) relates the phenomenon of "MySpace Angles": The prevalence of user profile pictures on MySpace which are taken from an extremely favourable angle and the "policing" of this practice in the form of criticism, satire and exposure of pictures that more closely resemble the users' real-life looks.

It could be said that the degree of expected or tolerated “role-playing” versus “authenticity” varies depending on the context. In social networking platforms that primarily help us “stay in touch” (as *Facebook* puts it) with the friends we know in person, we expect a great deal of authenticity, whereas in communication platforms about and around computer games, for example, the play-element is strong enough to warrant a high degree of role-playing.

A related consequence of the disembodiment may be the different construction of social status or a lack thereof. It has been indicated that online-communication may be more egalitarian, as the social status is generally not communicated (Misoch 2006, p. 72) and more content-focussed (ibid., p. 70). A negative consequence are a number of problematic behaviours, which are examined in the following section.

2.4.5 Group Dynamics & Problems

Apart from misunderstandings and problems that can arise from the textual and asynchronous nature of the medium (such as unrecognised irony, due to the lack of nonverbal cues), a discussion forum or mailing list consists of a group of people and is therefore susceptible to all the problems that can arise in any group.

First of all, a *group* is, very generally, a number of people who share some characteristics or interests. Following Tönnies (via Misoch 2006) we shall further distinguish between *community* and a *society* in our discussion of groups. The latter is a coexistence of people that is determined by organisational, rational and institutional structures; the relation to each other is created by, for example, geographic or economic space. A *community* is characterised by a subjective-emotional feeling of being-together; it is close, familiar, primal and implies solidarity and readiness to help; family, friends and neighbourhood are (ideally) communities.

Identifying online communities

Characterising online-communities is difficult, but Misoch (ibid., p. 157) identifies nine requirements: Interactivity, a multitude of users, persistent membership, a virtual space, establishment of common rules and norms, support function, identification processes, emotionality of contact and genesis of stable friendships, user friendliness of the supporting

system. It is not necessary to go into depth for all of these criteria, but two examples shall highlight that subject-specific online discussion forums can indeed become communities.

First, Amon (2004) investigated the *consol.at* videogame discussion forum and reports the following case: A user adopted a second identity in the forum, pretending to be a different person. When the moderators of the forum found out about it, they banned the user from participating in the discussions. Immediately, a multitude of other users posted statements of solidarity with the banned user in a thread, mentioning how they thought the user was an active contributor and had not deserved such a treatment without warning. Following this and an apology by the user to the moderators, the ban was lifted a few days later. This is a prime example of the “support function” and of emotional connections to each other.

Another good example is *informatik-forum.at*, the primary online discussion space for all computer science students at Vienna University of Technology and University of Vienna. The sub-forums for various undergraduate computer science programs and for their common subjects are, by far, the ones with the most posts (but it should also be noted that some courses use this forum as a way for the tutors to communicate with the students). However, they are followed (in post count), not by the graduate programs sub-forum or the “general issues” sub-forum, but by the “off-topic” sub-forum, which includes threads on smoking ban polls, health insurance questions and iPhone tricks - in one word, many things that are in no way specific to computer science students, but are still discussed, presumably because the forum members value the opinion of (at least some) other posters.

Flaming

The emotional ties to the community and the disembodiment in an online discussion forum provide a fertile ground for communication patterns that are not generally desired. One such problem is *flaming*, a degeneration of a discussion into highly polemic argumentation, insults and abusive language. Lee (2005, p. 387) points out that the “low social presence of CMC results in deindividuation, in which feelings of embarrassment, guilt, empathy, and fears of retribution and rejection are generally reduced”. This “low social presence” is due to the physical absence and relative anonymity⁵. Lee (ibid., p. 388) tries to categorise strategies of coping with flaming: competitive-dominating (denouncing, escalating), cooperative-integrating (apologising,

⁵ A personal observation shows that flaming is not very present on the generally non-anonymous Facebook

mediating, joking), and avoiding (withdrawal) strategies. Even if a “flame war” is ended diplomatically, Lee finds that the “agreement to disagree” stands in contrast to the “recognition of the impossibility of relativism”, i.e. the “desire to achieve persuasion provides the initial and constant motivation for rhetoricians to perform” (Millard, in Lee 2005, p. 400). Lee also finds that flaming, as a form of conflict, is not necessarily negative (as conflict performs important functions in human relationships), and that it can even become a ritual or an expression of affection (especially in a somewhat homogenous group of people).

Dix et al. (2003) offer another approach to understanding flaming: They suggest that the reduction to a textual channel in AOD makes it necessary to express emotional involvement more directly and verbally, and, at the same time, makes it harder to get emotionally involved at all, paradoxically resulting in “more heated conversations by calmer conversants” (Dix et al., 2003, p. 497).

Trolling

While flaming can be regarded as a degeneration of discussions, *trolling* is a different problem:

In Internet slang, a troll is someone who posts inflammatory, extraneous, or off-topic messages in an online community, such as an online discussion forum, chat room, or blog, with the primary intent of provoking other users into a desired emotional response or of otherwise disrupting normal on-topic discussion.

(“Troll (Internet)”, Wikipedia)

Trolling is intentional and often very clever. Trolls sometimes ask seemingly naive and stupid questions or make provocative comments (without really having the attitude they claim to have), “baiting” the other users. Again, the anonymity of many online-forums and the possible differences in socio-cultural backgrounds make it easier to troll, as it is hard to tell whether someone is being genuine about their attitude. In terms of Habermas’ communication claims (intelligibility, truth, truthfulness and correctness; see 2.1), trolling constitutes a complete breaking of the claim to *truthfulness*, while the other claims may be left intact.

Why someone would rise to the bait can be seen from Matthatias Schwartz, who interviewed Jason Fortuny, a notorious troll, for the New York Times Magazine:

"You have green hair," he told me. "Did you know that?"

"No," I said.

"Why not?"

"I look in the mirror. I see my hair is black."

"That's uh, interesting. I guess you understand that you have green hair about as well as you understand that you're a terrible reporter."

"What do you mean? What did I do?"

"That's a very interesting reaction," Fortuny said. "Why didn't you get so defensive when I said you had green hair?" If I were certain that I wasn't a terrible reporter, he explained, I would have laughed the suggestion off just as easily. The willingness of trolling "victims" to be hurt by words, he argued, makes them complicit, and trolling will end as soon as we all get over it.

(Schwartz 2008)

Hence, some forms of trolling can be regarded as therapeutic by their enactors, just as many hackers see it as their calling to unveil security holes in computer systems by exploiting them without causing any serious harm. Some trolling includes harassment and other illegal activities, but the majority does not; Schwartz (ibid.) suggests some strategies of mitigating those instances: Intervention of human moderators (as is common in forums), intervention of automated or semi-automated processes (such as "Robot9000", an experimental section on the troll-infested message board 4chan.org) and simply recognising trolling and not reacting to it: Users sometimes point trolling out to each other: "Don't feed the trolls". The hope is that, in the end, it may be that "we all get over it".

Other Problems

Beck (2006, pp. 111 ff.) recognises some other communication problems:

- Participation below a *critical mass*, i.e. not enough users who post more or less regularly
- Too much off-topic discussion where off-topic is not desired. Depending on the visual organisation of the posts, a discussion may be hard to get back on track once an off-topic "sub-discussion" has evolved.
- Identity deception: For trolling purposes; to impersonate other forum users; or just to hide one's identity (for legitimate or illegitimate purposes, e.g. to circumvent a ban).

3 Discussion and Learning

3.1 Schools of Learning

Before considering discussion systems for learning, it is necessary to clarify what definitions and paradigms of learning the following considerations are based on. Anderson (2008) identifies three more or less traditional paradigms and one newer concept of learning: *Behaviourism*, *Cognitivism*, *Constructivism* and George Siemens' *Connectivism*.

1. *Behaviourism*. "The behaviorist school sees the mind as a black box, in the sense that a response to a stimulus can be observed quantitatively, thereby ignoring the effect of thought processes occurring in the mind. This school, therefore, looks at overt behaviours that can be observed and measured as indicators of learning." (ibid., p. 20) The learning process can only be discussed in terms of the observable actions that result from it, the learning goal is a change in behaviour.

2. *Cognitivism*. "In cognitive theories, knowledge is viewed as symbolic mental constructs in the learner's mind, and the learning process is the means by which these symbolic representations are committed to memory." (Cindy Buell, cited by Siemens 2004) The learning process depends on the mind as an information processing system, on its memory constraints and other cognitive characteristics.

3. *Constructivism*. In constructivist approaches, it is assumed that knowledge is not transferred or internalized, but constructed by the learner. Learning is situated; learners need to contextualize the information they are given. Real-life learning is "messy and complex" (Siemens 2004). This view is tied to epistemological constructivism, the proponents of which "reject the view that science discovers a determinate structure to reality" (Downes 1998)

4. *Connectivism*. In his seminal 2004 essay, George Siemens proposed a new concept of learning that is adapted to the changed requirements of the digital age: Vast amounts of readily available and rapidly growing knowledge, ease of communication, requirements changing at a fast pace, storage and manipulation of knowledge in machines. Some key requirements for "connectivist" learning are:

Learning and knowledge rests in diversity of opinions.

Learning is a process of connecting specialized nodes or information sources.

Learning may reside in non-human appliances.

Capacity to know more is more critical than what is currently known. [...]

Ability to see connections between fields, ideas, and concepts is a core skill.

Currency (accurate, up-to-date knowledge) is the intent of all connectivist learning activities.

(Siemens 2004)

In instructional design - the discipline of creating learning materials and tools that follow the requirements imposed by learning theories - it is assumed that there is no school of learning that is, in every case, better than the others. Instead, those models should be chosen to inform the design process that are most appropriate, depending on factors such as the level of the learner. In the following sections, it will become apparent why constructivism and connectivism provide a particularly good theoretical foundation for learning through dialogue and discussion. (Mergel 1998)

3.2 Theories of discussion and learning

In “Orality and Literacy”, Ong (2002) reminds us that even as Ancient Greek culture had performed its transition from a primary oral culture to a literate one, the dialogue-partner(s) in written texts served as a counterpart to structure thinking - this is best exemplified in the work of Plato, featuring Socrates’ teachings in the form of dialogues in which the philosopher refutes the other’s arguments. As Olga Dysthe (2002) points out, it has become a widely accepted notion that interaction and discussion with others, not only instructors, enhances learning. But what are the arguments for this? Why and how does learning through dialogue happen?

3.2.1 Texts as thinking devices

Based on the thoughts of Russian philosopher Mikhail Bakhtin, Norwegian psychologist Ragnar Rommetveit and Estonian semiotician Yuri Lotman, Olga Dysthe (ibid.) argues that texts are thinking-devices, with differences in interpretation by the sender and receiver being constitutional to the generation of new meanings. She calls this function *dialogic*. All texts,

however, have, at the same time, another mode: The direct conveyance of the message (the *univocal* function). A defect of one mode is, by definition, the norm of the other one: A perfectly unambiguous transmission of meaning cannot be dialogic, but meaning cannot be generated if there is no room for ambiguity. All texts, however, contain both functions; they may vary in importance with respect to the context in which they are uttered and interpreted. Dysthe also points out that “participation [in a discussion] does not ensure dialogue” (ibid., p. 344). Active engagement with each other’s contributions is crucial; simple turn-taking, even if contributors explicitly reference each other, does not automatically entail productive dialogue.

This dichotomy is similar to Flusser’s distinction between dialogic and discursive media mentioned earlier; there are differences, but the point in which the systems concur is that dialogue can give rise to new ideas, to meaning and understanding - in short, we can learn through dialogue.

But are there psychological or sociological explanations why the dialogic function can result in learning?

3.2.2 Social learning and situated cognition

Why a dialogue with many is fundamental to learning is best explained by Vygotsky’s social development theory, Wenger’s theory of communities of practice and the notion of *situated cognition*. Hung & Chen (2001) outline these concepts as theoretical underpinnings for successful e-learning communities.

One of Vygotsky’s assertions, seminal to discussions about collaborative learning, is that social interaction is constitutive to cognitive development since “the higher mental functions rely on the mediation of behaviour by signs and sign systems” (ibid., p.5) and “a sign is always originally a means used for social purposes, a means of influencing others, and only later becomes a means of influencing oneself.” (Vygotsky cited by ibid., p. 6) Put another way, articulation of something for the purpose of communicating it – even if it is never communicated – changes one’s own understanding of it.⁶

⁶ I suggest that this provides an explanation for a common phenomenon: When we are stuck in a difficult problem, it is sometimes enough to ask another person for their opinion, and the solution will appear clearly in our mind - without even waiting for the answer. By mediating the problem through coherent signs, we enable it to be properly processed by our “higher mental functions”.

A key concept in Vygotsky's theory is the *zone of proximal development* (ZPD), comprising all problems one can solve and concepts one can understand under guidance of a "more knowledgeable other" (Learning Theories Knowledgebase 2010), but not alone. Allen (2005, p. 249) outlines how the ZPD theory has been used to explain that when a problem is approached in collaborative action, individual knowledge will eventually turn into a constructed, shared knowledge. It is clear that the premises about learning are those ascribed earlier to the school of constructivism. In fact, Vygotsky's approach is sometimes labelled as *social constructivism*. (Atherton 2010)

Closely related is the idea of *communities of practice*: This type of community is constituted by "collective learning in a shared domain of human endeavour", as defined by Etienne Wenger (2006), one of the people to coin this term. A domain is a field of interest, professional or not; being part of a community involves mutual help, discussion and activities; and practice entails the development of a "repertoire of resources" (ibid.). Communities of practice are formed by "socially constructed beliefs and ways of thinking" (Hung & Chen 2001, p. 6). By participating in the social interaction (communication) of a community, one gradually and implicitly acquires its knowledge. The last point is crucial – social learning does not have to be intentional. In fact, more often than not learning takes place outside an explicit learning situation. (Allen 2005, p. 250)

The point of *practice* is especially relevant for the concept of *situated cognition*. This notion states that "knowledge is not just a mental state; rather, it is an experienced relation of things, and it has no meaning outside of such relations" (Hung & Chen 2001, p. 4, after Dewey). This emphasises one's ability to perform practically in situations rather than one's accumulated knowledge. Arguably, learning socially in a community of practice is more in line with this view of cognition than traditional instructional knowledge transfer. It is also perfectly compatible with Siemens' claims mentioned above, which call for learning strategies in an age in which access to information is easier and cheaper than ever.

3.2.3 A model for the learning process

The second question is: how do we learn through dialogue? What does the learning process look like, especially in an online discussion platform? To explain the process, Xin & Feenberg (2006) identify "four pedagogically significant layers of online educational discourse" which they

tie to established theories of communication and learning: *Intellectual engagement*, *Communication and common ground*, *Dialogue and motivation* and *Group dynamics and leadership*. The authors provide a detailed, valuable analysis of learning in AOD. On the following pages, their ideas are outlined and amended by similar theories as well as remarks pertaining to concepts of AOD discussed in earlier chapters.

Intellectual engagement and discussion goals

Intellectual engagement means explicit performances: *Foreground processes* such as “presenting examples, elaborating arguments, criticizing views, defining terms, applying concepts” (ibid., p. 4). This can be regarded as a case of v. Thun’s “objective content”.

The goals of this layer (the *foreground process*) coincide with the goals of initiating the discussion in the first place: “The goals of intellectual engagement through collaborative discourse are to achieve convergence at the group level and conceptual change at the individual level.” (ibid., p. 6) *Convergence*, as Abfalterer (2007, p. 79) defines it, means, in a discussion context, a need for some agreement or decision to be made, while in *divergence*, its opposite, the complexification, or the exchange of facts, perspectives and opinions is the central purpose. Xin and Feenberg argue that these two cases are, in fact, reconcilable - necessarily so, because while convergence is usually desired if the subject matter is a scientific fact or theory to be understood, it may be nearly impossible (and not required) in the case of, for example, humanities or arts.

The pursuit of this sort of convergence is heuristic rather than substantive. Thus it is commonplace for teachers to conclude a discussion before everyone is in agreement, once the back and forth of argument has brought out the various positions clearly.

(Xin & Feenberg 2006, p. 7)

“This sort of convergence” is tantamount to Abfalterer’s *divergence*, since the purpose is the exploration of possible arguments and solutions rather than the agreement on one in particular. Xin and Feenberg also present several theories on the process of arriving at this convergence/divergence, all of them essentially amounting to a “general process of development from the loosely connected small talk of the outset to joint discussion of a shared theme to the resolution of disagreements in a convergent conclusion.” (ibid., p. 9)

Communication and Common Ground

In a *background process*, the *common ground* of shared assumptions, on which all discussion must be founded, is enlarged in the course of the discussion, by continuously *grounding* new contributions and *repairing* problems in understanding.

While the “content specification” comprises a contribution itself, the “content grounding” is the process of creating mutual belief that the contribution has been understood. In face-to-face discussions, grounding happens by a showing of acceptance through *continued attention*, *initiation of relevant next contribution*, *acknowledgement*, *demonstration* or *display*, in increasing order of strength. In AOD, *continued attention* is hard to convey (as its verbal manifestation is silence, and AOD is limited to verbal utterances); *initiation of relevant next contribution* poses a timing problem (as enough time will mark the response as a separate contribution); *display*, the verbatim repetition of a contribution, is made independent of human memory by copy-&-paste and is weak in AOD, unless a special mechanism is employed (see below). *Acknowledgement*, such as the interjection of nods or “uh huh”s, is acceptable in synchronous forms of online discussion (via simulated backchannels), but less productive in AOD, unless it is connected to an a further individual contribution. *Demonstration*, the (partial) reformulation of a preceding contribution in one’s own words, is most effective in AOD. (Xin & Feenberg 2006, pp. 6-12)

A common mechanism to allow for using *display* in a credible manner in AOD is quoting, whereby the words of the original presenter (A) are quoted by B through a quote-function that copies A’s words with a special marking into B’s own post. B can then respond to the whole quote or cut it up into sections. Quoting not only serves to show acceptance (in terms of the grounding, not necessarily in terms of the specification), but also allows participants to “keep track” of a discussion regardless of the layout in the system.

Repair, whereby misunderstandings are corrected (and prevented, where possible) to allow grounding, is made more difficult in AOD due to the time gaps, infrequent turn-taking, lack of redundancy (of communication channels) and lack of nonverbal cues, and might call for leadership, i.e. a moderator. (Dix et al. 2003, p. 488 and Xin & Feenberg 2006, p. 12).

Relation between background and foreground processes

Intellectual engagement and common ground together result in an iterative process: “[E]ach cycle begins with an enlarged common ground resulting from the shared understanding and group

convergence so far achieved.” (Xin & Feenberg 2006, p. 12) But there are deeper relations between background and foreground processes. Xin and Feenberg call the three general phases identified earlier *topic initiating*, *multi-logue* and *common-logue*. Fig. 3 shows the relation between intellectual engagement and common ground according to these phases.

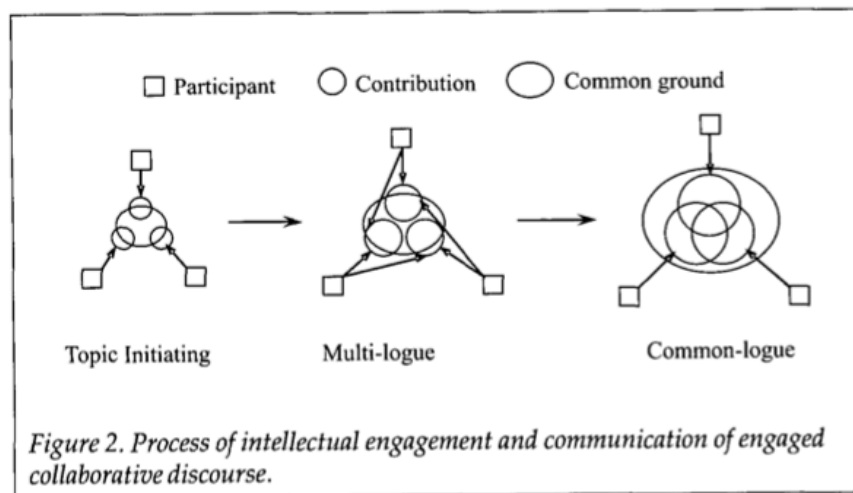


Fig. 3: Relationship between individual contributions and common ground (from Xin & Feenberg 2006)

This is a very general model and has many exceptions. Arguably, however, it is everyone’s implicit idea of a balanced and productive debate. In *topic initiating*, terms and problem boundaries are defined (*foreground*); assumptions and shared experience are identified (*background*). The limits of shared understanding are tested. In *multi-logue*, the participants “agree and disagree, clarify and elaborate” (ibid., p. 14) and reach convergence in informal subgroups (*foreground*); the common ground is enlarged considerably by the end of this phase (*background*). In *common-logue*, relative convergence (in the sense discussed above) is reached and, through this, individuals acquire new knowledge (*foreground*); horizons are fused as the common ground embraces the entire group (*background*).

Dialogue and motivation; leadership

There might be an external reward (such as contribution to the grade) when AOD is used in a teaching and learning context, but why, then, do people keep discussing issues on public message boards? “Surprise, suspense and a sense of accomplishment” (ibid., p. 4) are some of the

intrinsic motivations to participate, like in a game, where - although there might be an extrinsic goal of winning - once playing, the players will be captivated by the play itself. Xin and Feenberg provide sports as an analogy: “[...] dialog resembles relaxed volleying rather than a serious match. [...] The true pleasure of playing at online discussion consists in making moves that keep others playing.” (ibid., p. 16)

This captivation can be described as intrinsic motivation. Intrinsic motivation is an enormous resource: It causes us to do everything we do that is not tied to a reward or punishment given by others (such as payment or coercion) and not an immediate physical need. Personal intrinsic motivation, as identified by Edward Deci, is fuelled by the desire to be autonomous and/or the desire to be competent. Intrinsic motivation is fragile, however: In experiments conducted by Deci, subjects were asked to complete puzzles. Originally, they were not rewarded for it. When, in another session, they were rewarded for how many puzzles they solved, their engagement with the puzzles during breaks (i.e. when they were free to do whatever they wanted) increased, but when that reward was taken away again in another session, their engagement during breaks fell below the original measure. By attaching an (extrinsic) reward to an activity, its intrinsic value may decrease – and not rise again, even if that reward is removed. (Shirky 2010)

Intrinsic motivation to discuss is achieved by feeling accomplishment through understanding. In any form of teacher/student dialog, the teacher causes the student to make “active mental connections” (Xin & Feenberg 2006, p. 16). Xin and Feenberg also draw upon Vygotsky’s concept of the zone of proximal development. By guiding a discussion, the teacher can ideally enhance the participants’ motivation. The guidance, however, must be of an appropriate amount, so that the teacher neither dominates the discussion nor leaves it unsupervised. The teacher also has to contextualise contributions, monitor students’ participation and be sensitive to social dynamics within the group.

3.3 Studies and Observations

In the following sections, some observations of student behaviour in AOD for university classes are discussed.

3.3.1 A small-scale discussion

Olga Dysthe (2002), with her theoretical framework mentioned earlier and with the purpose of identifying the learning potential by means of analysing the dialogicality of the texts, investigated an AOD component of a postgraduate course in “Moral Theory and Moral Reasoning”, with ten participants some of whom were not able to meet regularly with the others. Participation in the AOD was neither compulsory nor graded. The teacher posted an open question and over two weeks 27 contributions were made by nine students, with an average length of 300 words. To code the contributions, she categorised them in *explicit interactions* (direct answers and comments, with a reference to another contribution), *implicit interactions* (answers and comments that do not explicitly reference another contribution, but do so by their content) and *independent statements* (not answering or commenting to another contribution).

Dysthe made several interesting observations (ibid.). All entries engaged with ideas of other contributions, and all engaged with the teacher’s original question (most also explicitly); some contributions, however, received more engagement than others. Many contributions referenced several other posts, which is characteristic for AOD in comparison to face-to-face discussions, where time constraints and faster turn-taking usually makes this unfeasible (except for strongly moderated and time-constrained discussions, in which turns are scarce and must be made use of). Also, Dysthe claims that all voices were heard here, in contrast to face-to-face situations, in which students who find it hard to express themselves quickly enough might not be able to contribute what they would if they had more time to reflect upon it. Also, applying Lotman’s theory, Dysthe found it possible to recognise dialogical and univocal parts in most contributions, the former as references or argumentative discussion, the latter in examples or “points of principle”.

In this example, the teacher only contributed the original question and one minimal intervention. According to Dysthe, crucial for the dialogicality was the authenticity and engaging character of the teacher’s question (unsurprisingly), and the symmetry of participants, i.e. the equality in formal status and general level of knowledge.

3.3.2 Some structuring methods

While in the above example the only constraint that was imposed on the discussion was the original question, factors such as a larger group, less symmetry among participants or a topic that

calls for more convergence might necessitate more structure. Darabi et al. (2010) investigate some possibilities, in the light of the notion of *cognitive presence*. Cognitive presence is a measure of the successful completion of four phases of *critical inquiry*. The latter phases (*integration* and *resolution*), the authors argue, are not sufficiently facilitated by unstructured AOD systems.

Four structuring methods were investigated in a study with 73 undergraduate students over the course of a semester:

- *Scaffolding*: Student mentors continuously raised questions that should lead to convergence (to the extent desirable or possible, as mentioned earlier). Scaffolding can be regarded as an application of Vygotsky's *zone of proximal development* (Xin & Feenberg 2006, p. 16).
- *Pre-structured*: Different threads were focussed on one specific question each, similar to discussions on traditional web-based bulletin-board systems.
- *Forced debate*: Students were randomly divided into two groups, one for and one against a given point of view.
- *Role-play*: Each student had to assume the role of a professional in their field.

The results indicated that *forced debate* and *role-playing* support the middle and later phases of learning more than the rather usual *structured debate*. So did *scaffolding*, but that was particularly beneficial for the last phase (*resolution*), in which the learners arrive at something to “take away” from the discussion. It must be noted, however, that the authors estimated cognitive presence from the number of “segments”, i.e. parts of contributions discernible as meaningful statements, and calculated statistically significant differences between the structuring methods from the frequency of these segments alone.

3.3.3 Moderation and facilitation

[T]he teacher who consciously tried to promote face-to-face dialogic interaction among students with a high learning potential took on the following functions: posed authentic questions, provided ‘uptake’ (repeating key elements of what students said in order to make others engage with the ideas), summarised, challenged, offered new information,

and provided opportunities for reinforcing learning [...]. These are functions which a moderator or teacher *could* take on also in a computer-mediated discussion [...].“

(Dysthe 2002, p. 346)

Considering this experience and the *zone of proximal development / scaffolding* / “Socratic questioning” theme, facilitation by the teacher/instructor appears to be a viable way of increasing learning outcome (as some kind of convergence or integration/resolution can be ensured). In addition, Correia and Baran (2010) point out research proposing that facilitators’ role comprises, apart from the *intellectual* function just described, *social* and *organisational* functions: Reinforcement and encouraging feedback prompts on the one hand, stating objectives and procedures on the other hand.

Facilitating, be it by instructors or by peers, is also important to keep discussions on topic, as Dysthe’s case study and research by Beaudin (1999) indicate. Beaudin concludes that, next to asking the right initial question, rephrasing the question and summarising the discussion are some of the most important facilitator functions.

However, Correia and Baran (2010) also argue that instructor-only facilitation may lead to instructor-centred discussion, inadvertently suppressing student participation. They suggest encouraging peer-facilitated discussion and, based on several studies to test their ideas and on research by others, they find that 1) small discussion groups are easier to follow and allow students to feel that other students take notice of them, 2) instructors should still participate in the discussion as “learners”, offering opinions, experience and advice, 3) instructors should not retreat from the general design of the discussion and should be familiar with the course context and with the students, 4) instructors should train the student facilitators sufficiently for their task, 5) topics linked to students’ practices and needs should be selected (this is in line with the theme of *situated cognition* and *communities of practice*), 6) the AOD part should be aligned with other parts of the course, 7) students should be allowed and encouraged to volunteer to lead a discussion, rather than having this role imposed on them.

3.3.4 Assessment

In education research, a distinction is often made between *summative* and *formative* assessment. *Summative* assessment aims to evaluate a student after their performance (e.g. a final

grade) while *formative* assessment consists of giving students feedback during the learning process in order to help them reach the learning goals (Prins et al. 2005).

When AOD is used to support a course in higher education, it is often made compulsory and student contributions are assessed and count towards the grade. This may be a viable strategy, especially if the instructor feels that the ability to reflect and argue convincingly in a debate among knowledgeable peers is a more desirable learning outcome than the mere “acquisition” of knowledge or even the argumentation in an artificial examination situation, and thus replaces exams, for example, with online contributions. Hence, summative assessment is applied to students’ contributions.

But, as we have seen earlier, official summative assessment may cause students to contribute minimalistic, shallow statements that do nothing to invite an in-depth discussion. Hammond (2005) points out that recent research comes to the conclusion that summative assessment should still be performed by the instructor, but formative peer assessment (i.e. students assessing each other in the learning process) should be encouraged. He does not, however, specify the optimal means to perform peer assessment. Prins et al. (2005) suggest that mere rating or grading may evoke negative reactions from the assessed and recommends constructive qualitative feedback.

3.3.5 Problems

Cheung & Hew (2010) report the following main problems they have observed over years of using AOD in higher education:

- Students go into assignment mode, meaning that they only contribute shallow posts that are just good enough to complete the assignment. The authors suggest discussing what constitutes a good debate with the students beforehand and posing open-ended and challenging questions.
- Students claim that they have no time to participate in the discussion. Hence, AOD activities should be coordinated so that they do not coincide with other heavy commitments.

- A lack of in-depth critical thinking, i.e. too little justification, too few challenges and expressions of dissent. The authors suggest the following measures: 1) Allow students to become familiar with each other to lower the barrier for challenging each other; 2) grant students anonymity, for the same reason; 3) assign roles, as described above in the role-play structuring method; 4) train facilitators to use “Socratic questioning”, the probing of assumptions, evidence, viewpoints and implications through focussed questions. This appears to be not dissimilar to the scaffolding technique described earlier.

The last point suggests that proper facilitation is crucial to successful discussions, especially when there is a learning goal of some sort of convergence.

3.4 Conclusions and Principles

3.4.1 Main differences between AOD and face-to-face discussions

Differences between online and face-to-face discussion have already been described in chapter 2. But with the theories and observations of AOD with respect to learning processes, several important issues that set AOD apart from in-class face-to-face discussions shall be summarised:

- Problems of grounding. The acknowledgement of points one has made is made more difficult in AOD through the lack of nonverbal cues (backchannels) and may require special mechanisms such as quoting.
- Multiple references. Slower turn-taking and more time to formulate one’s answer lead to an increase in message length. Longer messages and a slow conversation pace make it more economical to address several other contributions in one message rather than answering each in turn. Also, information from different contributions may be referred to because all of them are relevant to the message, but they are spatially and temporally too distant to be present in the reader’s mind. This problem is discussed as a design issue in 5.3.8.
- More reflection. The asynchronous nature and the necessity to articulate one’s thoughts in written form leads to a very different approach in formulating a response. Everything that sets written rhetorics apart from oral rhetorics applies, resulting in the necessity to follow

different argumentation strategies. Pena-Shaff & Nicholls (2004) argue that engaging in AOD “has the potential to strengthen writing skills and encourage more deliberate articulation of ideas” and Newman et al. (1995) report that in a case study, students using AOD showed more critical thinking in making elaborate statements and linking ideas (which would further support the connectivist program), and less in novelty. The explanation for the lack of novelty, the authors suggest, may be exactly the more thorough reflection – which is, after all, what techniques focussed on novelty, such as brainstorming, seek to minimise.

- Focus of attention. Pena-Shaff & Nicholls (2004), in their case study using a rather conventional BBS, found that most attention was paid to the earlier posts in a thread. In face-to-face discussions, the evanescent nature of oral language is conducive to a focus of attention on the newest (last) utterances, while in AOD it depends on which contributions are presented first when the user “enters” the discussion view.
- Off-topic discussions. Beaudin (1999) points out that while in educational face-to-face discussions the instructor is present and able to intervene when a discussion strays too far from the intended subject, the asynchronicity of AOD prevents such quick intervention.
- Lack of quality participation. The freedom to participate whenever convenient and the impersonal nature of AOD may contribute to the problems indicated in 3.3.5.

3.4.2 Requirements and recommendations

What recommended characteristics of a successful AOD system can we extract from the above theories and observations? Hung & Chen (2001) identify four dimensions of learning, essential to consider in the design of a learning community:

- Situatedness: The tasks and goals need to be meaningful and the “big picture” needs to be visible.
- Commonality: Shared interests or problems, required collaboration and shared sign systems (including jargon) make participation reasonable.

- Interdependency: Participants' expertise and perspectives need to be varied so they can profit from each other's contributions.
- Infrastructure: The mediating platform must provide rules and processes (such as the rules how to obtain points to use in a rating system), accountability mechanisms (such as the visibility of ratings) and facilitating structures (such as the website running the AOD itself).

We can summarise these factors and the theories and problems discussed earlier into the following requirements for an AOD system in e-learning:

Putting the AOD to situated use. The discussion must be aligned to the course context so that students can appreciate its relevance. This means a) that the AOD should be initiated when it makes sense, i.e. when it can be used to achieve something that is hard to achieve in a traditional instructional setting or even in face-to-face discussions, and b) that the AOD should provide functionality to connect discussions to parts of the theoretical or practical issues in the larger course context.

Supporting symmetry, commonality and interdependency. Symmetry, the participants' equality in status, was highlighted in chapter 3.3.1 as beneficial to an in-depth discussion, as the barriers are low to contribute and challenge others' opinions. Commonality and interdependency were mentioned above and are characteristics of a community of practice, which is, in turn, most fertile for implicit learning through social interaction. These criteria are strongly impacted by the composition of the student body, but through grouping, for example, imbalances can be addressed by the organisers. The system itself should provide mechanisms to support credibility and accountability. As credibility indicators, peer ratings can be used. While being less useful in terms of formative assessment (because of the lack of qualitative feedback), through peer ratings posts can be highlighted that are found to be valuable by a number of users, and users who have made consistently valuable posts can be identified as highly credible. Accountability, on the other hand, is in direct contrast to anonymity. A compromise can be status-based anonymity, i.e. users cannot know other user's real identities, but administrators and instructors can, to prevent intolerable behaviour.

Offering tools to structure and facilitate the discussion. Facilitators, be they instructors or peers, should be able to perform the activities discussed in chapter 3.3.3 so that they can keep the

discussion on topic and potentially employ scaffolding techniques to direct the students towards the learning goals. To remedy the off-topic problem, the AOD tools and the instructors' and facilitators' training must support similar intervention to that possible in face-to-face interaction in the AOD – or the AOD system must offer structures that either discourage off-topic discussions or allow them to be conducted without interfering with the on-topic contributions. Furthermore, facilitators should be visible as such and have the authority to remove inappropriate content. Functions that ease summarising, referencing and rephrasing may aid in the facilitators' tasks on the intellectual and social layer.

Heightening intrinsic motivation. Intrinsic motivation primarily stems from the will and ability of participants to engage with each other's ideas and show appreciation and respect. All these functions can be supported by mechanisms that also support symmetry, commonality and interdependency. In addition, poor usability deters people from coming back. It is necessary that participants are kept "in the loop" of the discussion and that using the system is a pleasant and effortless experience.

Providing specific mechanisms for:

- *Grounding:* Grounding mechanisms could include display by quoting, rephrasing by looking at the original post while writing the reply, and possibly indicators of presence (attention).
- *Multi-voicedness:* It must be possible to structure a contribution into several parts, be it through basic text structuring mechanisms (line breaks and paragraphs) or specific indicators that inform about the type of a part (such as response, idea or fact).
- *Multiple references:* Dysthe's study (see chapter 3.3.1) showed that multiple references within a single contribution are common in AOD. Functionality to make these references easy to discern and follow might encourage to use them more explicitly and thus connect the various arguments more visibly.
- *Time management:* As a lack of time is often a cause of little or shallow participation, an AOD system should be usable even if little time is available. Access should be fast and possible from a variety of platforms. Sub-discussions (contributions and their responses on multiple layers) should be discernible and easily classifiable by a participant as interesting to them or not, so that contributions can be made without having to read through all n

pages of a discussion thread just because it is impossible to filter out those topics and sub-discussions that are of no particular interest in the current situation.

- *Complexity management*: Complexity, arising from too high a number of contributions and too little structure, must be controlled, on the one hand, for reasons just discussed in the context of *time management*. On the other hand, it often makes sense to negotiate different subtopics within one thread, and heuristic convergence / divergence may only be reached if different lines of argumentation can be easily developed separately, without having to fork them into new discussion threads.
- *Summative assessment*: The system should provide functionality to ease summative assessment of students by the instructors, such as views that list a particular user's contributions in context.
- *Formative assessment*: Instructors should be able to perform formative assessment publicly (with appropriate means to reference, rephrase and summarise, as mentioned earlier), but possibly also privately, through, for example, private messages.
- *Peer assessment*: By rating each other's contributions while discussing through marking posts as "favourites" of some sort, formative (if crude) feedback is combined with complexity and time management, since concentrating on the higher-rated posts can be a good strategy to get an overview of a discussion.

4 The place of AOD in e-learning

So far, we have discussed why and how we learn through discussion and how we can implement this in an online environment, in particular for a course in higher education. But what is the larger context? What should e-learning comprise apart from discussion? What do current e-learning systems offer?

4.1 What is e-learning?

It is surprisingly difficult to find a recognised definition of e-learning. On Wikipedia, people define e-learning as “the computer and network enabled transfer of skills and knowledge”. It broadly designates any use of electronic media (typically a web-based platform) to enhance or replace a) non-electronic learning materials and/or b) non-electronic means of instruction, communication and collaboration. *Moodle*, one of the most popular e-learning platforms, offers functions such as broadcasting news and events, distributing a course schedule, posting associated documents, setting up media galleries, giving assignments with functionality for student-side upload and teacher-side grading, conducting surveys and graded quizzes, and using integrated forums and wikis.

In higher education, e-learning can be harnessed to facilitate the coordination of teaching large numbers of students, and/or to allow less frequent personal attendance.

4.2 “Web 2.0”

The result of the development that the internet has undergone in the past decade has been dubbed “Web 2.0”. This is certainly a “buzzword” that has been around for some years and has been used to describe everything from user participation to minimalistic, shiny logos; but in 2005, Tim O’Reilly identified core requirements for web 2.0 companies that are still valid five years later:

- Services, not packaged software, with cost-effective scalability

- Control over unique, hard-to-recreate data sources that get richer as more people use them
- Trusting users as co-developers
- Harnessing collective intelligence
- Leveraging the long tail through customer self-service
[for „the long tail“, see chapter 2.4.3, P.H.]
- Software above the level of a single device
- Lightweight user interfaces, development models, AND business models

(O'Reilly 2005)

As recent statistics show (Google 2010), fifteen of the world's top thirty websites, ranked by number of unique visitors in June 2010, conform to most of these criteria: “Traditional” services amended by community power and fuelled by a “critical mass” which makes user reviews and ratings work, like *Amazon* and *eBay*; media sharing services that span platforms and let their users tag content instead of subjecting it to a taxonomy, such as *Flickr*, *YouTube* and *Photobucket*; communication services such as *Wordpress* and *Twitter*; social networking services such as *Facebook* and *MySpace*; rich web applications such as *Hotmail*; and the unique monumental collaborative effort that is *Wikipedia*. The other half of the top thirty comprise eleven portals and search engines (which typically also incorporate some of the requirements) and only four “classical” company websites, unsurprisingly the biggest developers of end-user desktop applications.

Most of the technical characteristics only serve the biggest change in social interaction, a realisation of the potential mentioned in chapter 2.3: The change from a publish/consume model to the “read/write-web”, the change from a one-way mediation to a conversation. Permalinks, trackbacks, RSS and the progressively more interconnected news, (micro-)blogging and networking services make it easier than ever to find and contribute to an information exchange on any topic imaginable, and thus to converse in small, interconnected clusters within what has become known as “the cloud” of endless online communication.

With the support of Shirky (2008) and Graham (2005), it is reasonable to argue that after all, “Web 2.0” is the result of a process of changes in social behaviour that was enabled by internet

technology and natural to happen once such technology was available. The business models and web tools of “Web 2.0” are constantly expediting and reacting to these changes.

4.3 Technology and user experience in the “Web 2.0”

Scott & Neil (2009) describe a range of interaction patterns most of which have become both characteristic and indispensable for “Web 2.0” sites:

- *Direct manipulation*, with in-page editing (such as image renaming on *flickr.com*) and drag and drop.
- *Contextual tools* and information to make interaction effortless, e.g. providing context menus and always-visible controls.
- *Supporting the user’s “flow”* (state of mind of intent concentration on the task at hand) instead of disrupting the experience. Overlays, inlays, virtual pages and process flows are mechanisms for that. Virtual pages bring mechanisms we are used to from webpages to elements within those pages, such as scrolling. Process flows take the user through a series of steps without leaving the page.
- *Extending invitations* to interact via, for example, mouseover-events and affordances (the qualities of an interface element that make certain actions appear “natural”).
- *Using transitions* rather than sudden state changes to make processes more understandable, focus attention and create a more engaging experience.
- *Reacting immediately*. Progress bars, live search suggestions and automatic content updates make the use more efficient and convenient and bridge the “gulf of evaluation” (Norman 2002) that, if too large, keeps the user from judging system state appropriately.

These patterns are by and large only possible because of AJAX. AJAX stands for “Asynchronous JavaScript and XML” (Garrett 2005) and represents a departure from the “classic” web application model that would, upon a user action that requires a server response, send data to the server, process it and return a new HTML page as a result. With AJAX, data is sent and

processed in the background while the JavaScript interpreter and other browser functions continue as normal; when the response is ready, a JavaScript callback function processes it the way it needs to and, probably, modifies the page without reloading it, employing the DOM (Document Object Model) functionality to alter HTML content. This technology made it possible for websites to turn into proper web applications that are much closer, in behaviour, to desktop applications. It enables data-driven methods for inlays, in-page editing, transitions and live suggestions. It supports flow and does away with the disruptive page-reload. It is the technical foundation for “Web 2.0”.

4.4 “E-learning 2.0”

After everything that has been said about learning and discussion and principles of AOD systems, what can we deduct about the place of AOD in larger e-learning contexts? What place does it take and what place should it take in the light of the “new” internet-world of “web 2.0”? Stephen Downes suggests that e-learning needs to embrace a new paradigm, too:

What happens when online learning ceases to be like a medium, and becomes more like a platform? What happens when online learning software ceases to be a type of content-consumption tool, where learning is “delivered,” and becomes more like a content-authoring tool, where learning is created? The model of e-learning as being a type of content, produced by publishers, organized and structured into courses, and consumed by students, is turned on its head. Insofar as there is content, it is used rather than read—and is, in any case, more likely to be produced by students than courseware authors. And insofar as there is structure, it is more likely to resemble a language or a conversation rather than a book or a manual.

(Downes 2005)

Assuming that O’Reilly is right about the new uses of the internet and that Siemens is right about the new modes of acquiring and using knowledge, Downes proposes the only way to adapt e-learning to the way electronic media are used in professional and private life.

Popular e-learning platforms such as *Blackboard* or *Moodle* have AOD modules in the form of rather traditional “bulletin boards” (see 5.2.1 for details), with sub-forums to specific course-related topics. *Moodle*, an open-source e-learning system, for example, is structured in a way so

that the forums take their place as a module alongside others, as observed above. This means that all discussion takes place in a “separate room” that one can choose to ignore; a close link between materials and discourse is absent.

On such bulletin boards, users create threads and nested responses to these threads. These boards are typically a self-contained environment; in the light of Downes’ and Siemens’ claims, a form of e-learning that honours the changing use of information would prefer discourse that is more closely tied to the other course activities.

In this context, it is also worth noting that the mentioned wikis are sometimes used in e-learning. Wikis are a tool to collaboratively produce organised information. They do not require specialised knowledge to edit them, yet allow the creation of richly formatted online documents. A wiki page on a particular subject usually has a “regular” view with all the information and a “discussion” view on which users argue about changes. Wikis are, technically, a form of AOD, but in them, discussion is rather a means to an end than the end itself. It is usually much less convenient than in discussion forums to identify authors of posts or the evolution of a debate, because it is more important that the final text reads as an informative entry and appears coherent; convergence is much more relevant. I have found wikis in use as the only e-learning tool, for example, in several classes at the faculty of philosophy at the University of Vienna.⁷ Seminars in the humanities might profit from the use of wikis because the final “heuristic convergence” is usually unknown to the instructor: Argumentation is fundamental to these disciplines, and sometimes it may be desirable to record the outcome of the argumentation in a format that is readable as a self-contained text rather than as a transcript of a discussion.

The reason why wikis are a popular tool in e-learning is because they address the “web 2.0” requirement which is most relevant for learning: Harnessing collective intelligence. Whether grounding, convergence and divergence achieved through discussions manifest themselves primarily in the learner’s minds, as with bulletin boards, or also in a final coherent text, as with the wiki, the process is one that could not take place without mechanisms of connecting the different information and opinions of the participants’ minds. Amazon, for example, harnesses collective intelligence in order to always find a way to provide the most desired, most relevant information about products to customers. An e-learning system should harness collective

⁷ see <http://philo.at/wiki/> (retrieved on 16 June, 2011)

intelligence to maximise the learning potential for every participant. Learners should be empowered to take charge of their own learning, as Downes (*ibid.*) says.

But how can we make AOD systems more dynamic? Are there strategies to break out of the old bulletin-board scheme? What could we gain from such alternatives? In the next chapter, I will look at typical structures of AOD systems, strategies to address requirements and problems of learning through discussion and mechanisms that might be useful for e-learning applications.

5 Structure of AOD systems

Discussion forums and mailing lists have a number of more or less traditional ways of organising and presenting data to the user. By analysing a few of the most widely encountered systems, the strengths and weaknesses of each approach shall be highlighted.

In the early days of the internet, many-to-many discussion was best facilitated by mailing lists and newsgroups. Since then, the web has largely subsumed the latter (in the form of Google groups or Yahoo groups, for example) and even e-mail is often used via the increasingly sophisticated webmail services instead of separate client applications. For these reasons, I will almost exclusively look at web-based systems.

On the following pages, I report my observations of AOD systems regarding structure and specific mechanisms. The requirements for successful learning through online discussion (chapter 3.4) are measured in all types of existing systems, not only in e-learning contexts. One reason for this is that learning occurs in all sorts of online communication platforms, not only in ones that are specifically tailored to an educational frame. The other is that there are few openly accessible e-learning systems available, and fewer that have an interesting AOD component.

First, the general structural mechanics common to most systems are discussed. Then, a few systems that take notable approaches to some of the most common problems an AOD platform needs to solve are examined in detail. Finally, design patterns that can be observed in one form or other across a variety of systems are described and summarised.

5.1 Structural basics

The most basic distinction I am making is that between *forums* (web bulletin boards, Google groups etc.) and what I call *commentables* (news sites or blogs that allow readers to post responses to an article and to responses to that article). In the former, all content is generated by participants, with some exceptions in the form of announcements of general interest, for example, that are made by the moderators. In the latter, discussion is always an option, not a constitutive; all user participation is always related to a particular item that was published by a

group of people much smaller than the general user base, typically the “journalists” (an increasingly difficult term in the world of blogs) or site owners.

Discussions are grouped per thread (in forums) or item (in commentables). The biggest structural difference between various platforms is whether it is possible to respond to a response or only to the thread/article. In the latter case, there is only one layer of responses, in the former case, the discussion takes the shape of a tree-graph. In some cases there is a limit to the depth of the tree.

5.1.1 Thread overview

In *forums*, a thread is either explicitly created (bulletin boards) or begins automatically with a message that is not a reply (mailing lists). A thread commonly has a title, to provide information about the subject matter. A *forum* usually has some kind of overview which shows all threads and, possibly, the post titles in them.

- [Python competitions and learnings](#) *harrismh777*
 - [Python competitions and learnings](#) *Thomas 'PointedEars' Lahn*
- [Fibonacci series recursion error](#) *Jayme Proni Filho*
- [Python competitions and learnings](#) *harrismh777*
 - [Python competitions and learnings](#) *Alexander Lyabah*
 - [Python competitions and learnings](#) *Alexander Lyabah*
 - [Python competitions and learnings](#) *Terry Reedy*
 - [Python competitions and learnings](#) *Alexander Lyabah*
 - [Python competitions and learnings](#) *Alexander Lyabah*
- [Development tools and practices for Pythonistas](#) *Ben Finney*
 - [Development tools and practices for Pythonistas](#) *Shawn Milochik*
- [click](#) *DINESH PATIL*
- [Zope with MySQL](#) *harryjatt*
- [Getting number of hits from Google](#) *neocortex*
- [Fibonacci series recursion error](#) *Hans Georg Schaathun*
 - [Fibonacci series recursion error](#) *Steven D'Aprano*
 - [Fibonacci series recursion error](#) *Hans Georg Schaathun*
 - [Fibonacci series recursion error](#) *Steven D'Aprano*
 - [Fibonacci series recursion error](#) *Hans Georg Schaathun*
 - [Fibonacci series recursion error](#) *Chris Angelico*
 - [Fibonacci series recursion error](#) *Steven D'Aprano*
 - [Fibonacci series recursion error](#) *Hans Georg Schaathun*
 - [Fibonacci series recursion error](#) *Hans Georg Schaathun*
 - [Fibonacci series recursion error](#) *Chris Angelico*
 - [Fibonacci series recursion error](#) *Chris Angelico*
 - [Fibonacci series recursion error \(slightly OT\)](#) *Dave Angel*
 - [Fibonacci series recursion error](#) *Terry Reedy*
 - [Fibonacci series recursion error](#) *Hans Georg Schaathun*
 - [Fibonacci series recursion error](#) *Steven D'Aprano*
 - [Fibonacci series recursion error](#) *Hans Georg Schaathun*
 - [Fibonacci series recursion error](#) *Steven D'Aprano*
 - [Fibonacci series recursion error](#) *rusi*
 - [Fibonacci series recursion error](#) *Hans Georg Schaathun*
 - [Fibonacci series recursion error](#) *Robert Brown*
 - [Fibonacci series recursion error](#) *Steven D'Aprano*
 - [Development time vs. runtime performance \(was: Fibonacci series recursion error\)](#) *Teemu Likonon*
 - [Development time vs. runtime performance \(was: Fibonacci series recursion error\)](#) *Chris Angelico*
 - [Development time vs. runtime performance \(was: Fibonacci series recursion error\)](#) *Robert Brown*
 - [Fibonacci series recursion error](#) *Terry Reedy*
 - [Fibonacci series recursion error](#) *Chris Angelico*
 - [Fibonacci series recursion error](#) *Hans Georg Schaathun*

Fig. 4: Mailing list archive for the Python programming language.

A classical mailing list archive shows the threads in a tree format (Fig. 4). Note that this is just the archive; the ongoing discussions are participated in with mail clients or webmail applications. This view shows all threads and all posts within them, by their respective titles and authors. Every response beyond a depth of three (i.e. if more than three responses to the thread opening message precede it in the tree) is “flattened” in the view so that it appears to be at depth three, presumably because readability and compactness is usually more important than absolutely accurate representation of depth.


Title / Thread Starter	Replies / Views	Last Post By
 Sticky: [INFO] Aufheben der STEP in TUVIS++ bei Anrechnungen Started by klaus1, 12-07-2007 09:27	Replies: 36 Views: 8,536	IdealChain 03-03-2011, 19:31 
 Sticky: [Frage] Studienfreie Tage auf der TU Started by Wings-of-Glory, 09-06-2003 20:20	Replies: 38 Views: 16,660	arved 21-01-2008, 20:43 
 Übergangsbestimmungen Started by tdanecker, 11-06-2011 03:14  	Replies: 127 Views: 3,679	deathhero Today, 12:53 
 Time in Cyber-Physical Systems Started by Kampi, Yesterday 16:17	Replies: 2 Views: 84	serprime Yesterday, 17:24 
 Wo Anrechnungsformular ? Started by hütteldorfer, Yesterday 14:29	Replies: 2 Views: 89	hütteldorfer Yesterday, 14:33 
 Studienplan 2011 Started by Deldrarim, 25-01-2011 07:23      ...  ★★★★★	Replies: 506 Views: 30,520	Adok 14-06-2011, 10:01 
 [PROBLEM] Neuer Studienplan: Übergangsbestimmungen Informatik 2011 ??? Started by joehopf, 02-06-2011 13:38 	Replies: 18 Views: 953	kodiacc 04-06-2011, 17:35 

Fig. 5: Overview of threads on informatik-forum.at

Much more common are views that show only the thread title, and some information, such as the number of responses or the date of the last post; see Fig. 5. There is no information about the shape of the tree, if there is one. The advantage is that more threads can be shown in the same space and the redundant information of response titles is omitted, because these are often the same as the thread title (although a digression and subsequent title change can be observed in the “Fibonacci” thread in Fig. 4). The user can usually choose how to order the thread entries, but a common default option is ordering by date of latest post, so that threads with current activity are listed at the top.

An uncommon, but interesting approach is that of *4chan.org*. *4chan* is a bulletin board with sub-forums on a range of different topics (from anime to sports to pornography) where users can post anonymously. It is notorious for uncensored and offensive content and for spawning any number of *memes* (expressions or references that rapidly circulate among internet users). It

displays its threads in the thread view with the original post-content followed by up to five of the latest posts (with content) and a short notice in between about how many posts have been omitted. That way, one is, in a manner of speaking, already halfway into the detail view.

5.1.2 Thread Detail

In a *forum*, a user can typically click on a thread name and reach the thread detail view, most often a different page. In a *commentable*, the responses to the article are either shown by default or can be reached by a link named “view replies” or something similar. In the detail view, two different strategies (and hybrids thereof) can generally be observed.

Types of views

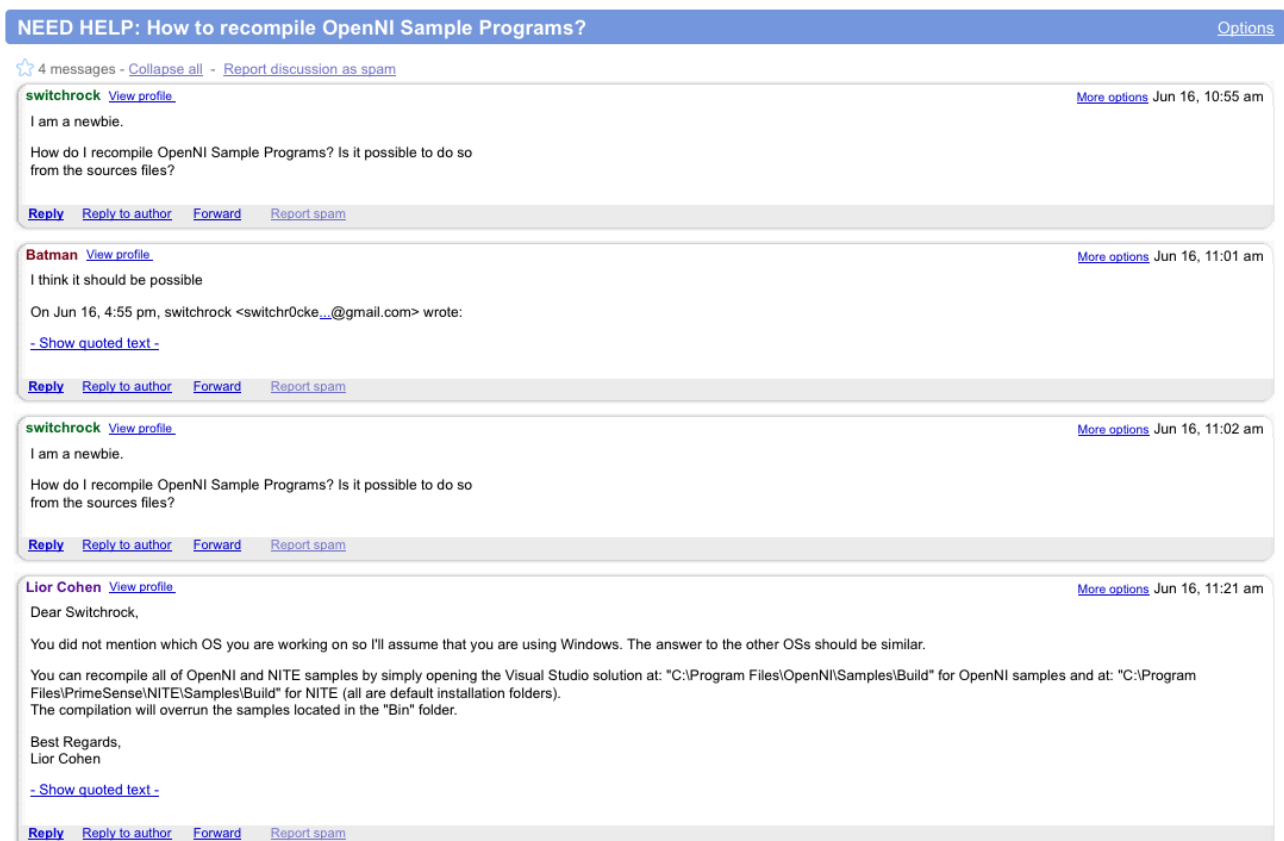


Fig. 6: A Google groups mail thread with a linear view.

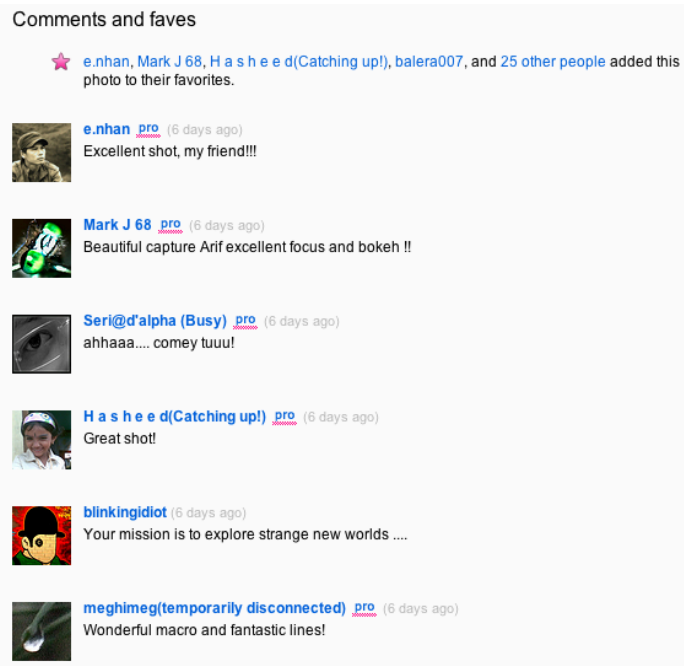


Fig. 7: Comments on Flickr.

The first type is the linear view. In this mode, all messages, regardless of whether they are, internally, in a tree structure or not, are displayed in the order of their post date and time, usually the earliest post first. Fig. 6 is a screenshot from a detail view of a Google groups thread, which could have been presented as the tree that it is, but was chosen not to. The linear structure can also be found in the comments sections of some blogs or media sharing applications (see Fig. 7), where there is only one level of responses. Generally, the contents of all responses are shown initially.

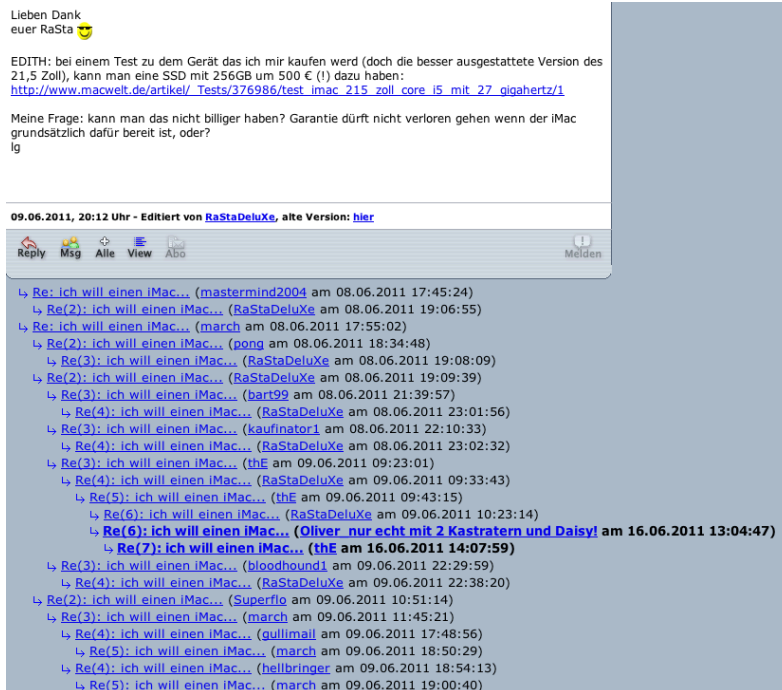


Fig. 8: Nested thread display on geizhals.at.



Fig. 9: Nested thread display on derstandard.at

The other extreme is a completely nested display, to be found in the forum section of the price comparison site *geizhals.at* (Fig. 8), in the comments section of the science/technology news site *slashdot.org* or in that of the Austrian newspaper site *derstandard.at* (Fig. 9). There are different strategies to cope with the size and complexity of the tree. *derstandard.at* simply shows the full tree including contents, indenting the sublevels only slightly and indicating the depth of a response by multiple arrow icons. *geizhals.at* shows the content of the original post and that of only one response at a time, all the others are reduced to their titles, with significant indentation corresponding to the depth. *Slashdot* has a fairly advanced system: The user can choose how many responses should be abbreviated (with only the headline visible, like on *geizhals.at*) and how many should be hidden (a hidden subtree of a total of four nodes would just be indicated as a leaf reading “4 hidden comments”) - see Fig. 14.

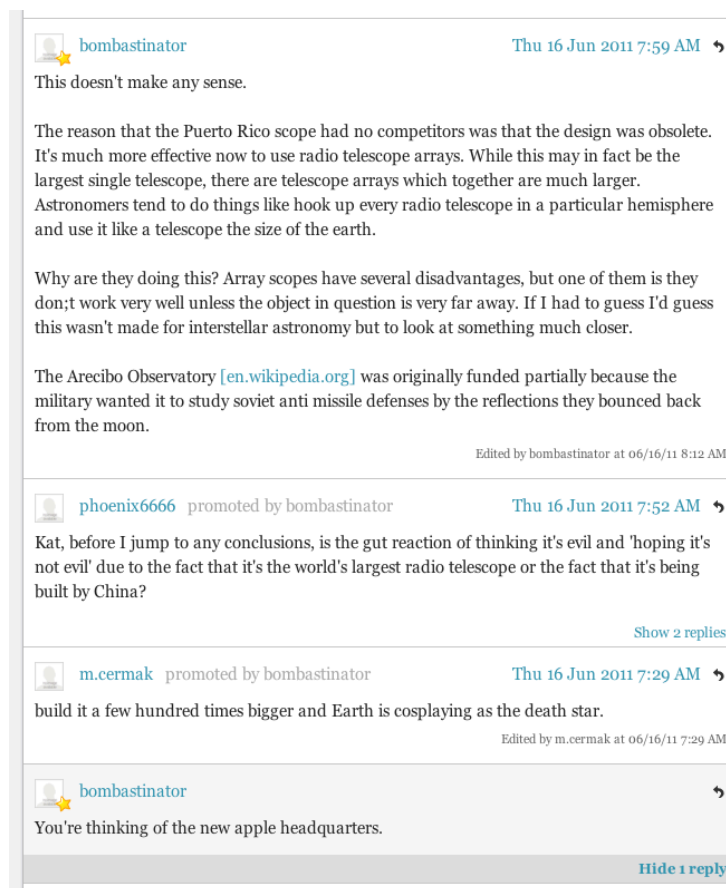


Fig. 10: Gizmodo’s hybrid of linear and nested view.

There are also hybrid strategies. Gadget blog *Gizmodo* (see Fig. 10) shows all replies to all threads by default, but gives the user the option to “hide n replies” for each top-level post, n being

the number of responses to that post. This is a compromise between retaining a compact, straightforward linear view and maintaining the tree structure to manage a large amount of posts. In addition, *Gizmodo* displays only a “featured thread” rather than “all threads” by default, drastically reducing the number of responses a user is initially presented.

In *vBulletin*, the forum software used by *informatik-forum.at*, the user can choose between *linear view* (all posts of a thread in linear order, like with Google groups), *threaded view* (a tree with post titles and a display of the post last clicked, similar to the *geizhals.at* forum) and *hybrid view*. The hybrid view is like the threaded view, except that it displays the contents of the whole subtree of the post that was last clicked on in the tree display. In this mode, the entire subtree contents of the thread-starting post are displayed by default, which amount to the entire thread tree.

Inlays

Scott & Neil (2009) introduce psychologist Csikszentmihalyi’s concept of “flow”, a state of optimal concentration on the task at hand, and the phenomenon of “change blindness”, the psychological fact that we find it easier to notice a change in visual information if there is no “flicker” (such as reloading the webpage) before the change happens. Due to these reasons, they argue, “inlays”, elements that appear within an existing display, are a good tool to allow a drilling-down into tree depth or details without disrupting the experience. While excessive page-reloads have mostly disappeared from current online communication platforms thanks to AJAX, the *vBulletin* strategy just described still loads the entire structure of a subtree upon the click, only highlighting the active post in the tree display. *Geizhals.at* and *Gizmodo* use inlays, but both have their disadvantages: On *geizhals.at*, the page scroll is set to the currently activated response, resulting in potential confusions, especially because one post is maximised and the previously activated one is minimised at the same time, disorienting the user. On *Gizmodo*, the inlay-subtree is highlighted as such only in that there is always a thin horizontal line before a top-level response. This way, the levels are completely flattened within a top-level response and its subtree, but the “conversations” are nicely separated. However, this separation is not immediately obvious.

Inlays are also used on tree-based views to reduce complexity, but, again, pose their own problems. Slashdot, for example, has control sliders for “hidden”, “abbreviated” and “full” posts but does not make it clear at first how the posts to be shown in any given configuration are picked (it turns out to be a mixture of depth and rating by other users); the inlay action, however, is smooth and not disorienting at all.

Participation

If there is any sort of tree structure present, the user can normally reply to the thread/article or any of the responses and sub-responses. There are exceptions, such as the comments sections on *fm4.orf.at*, the online presence of an Austrian radio station, where it is only possible to answer to top-level responses, effectively limiting tree depth to two, internally as well as visually. Reply forms are typically already visible or added as an inlay when the user clicks a reply button. In some cases, the reply is entered on a separate page (vBulletin, again, provides two options, with a “quick reply” on the thread details page) or even in a popup window (*derstandard.at*). The post is then attached dynamically via AJAX (*facebook.com*) or the original page is reloaded (*fm4.orf.at*).

5.2 Examples

5.2.1 Informatik-Forum: The bulletin board

The classical *Bulletin-Board System* (BBS) was a command-line application connecting users via modems and phone-lines and allowing them, among other features, to post threads with messages on a common platform. BBSs enjoyed popularity from 1978 to the mid-1990s, when they were all but replaced by web-based forums. (“Bulletin Board System”, Wikipedia) Today, there are several popular web applications that have taken on the legacy of the forum part of BBSs, such as *phpBB* and *vBulletin*. The latter is used, by the discussion platform *informatik-forum.at* (IF). This platform will serve as an example for a modern web-based BBS in the following observations.

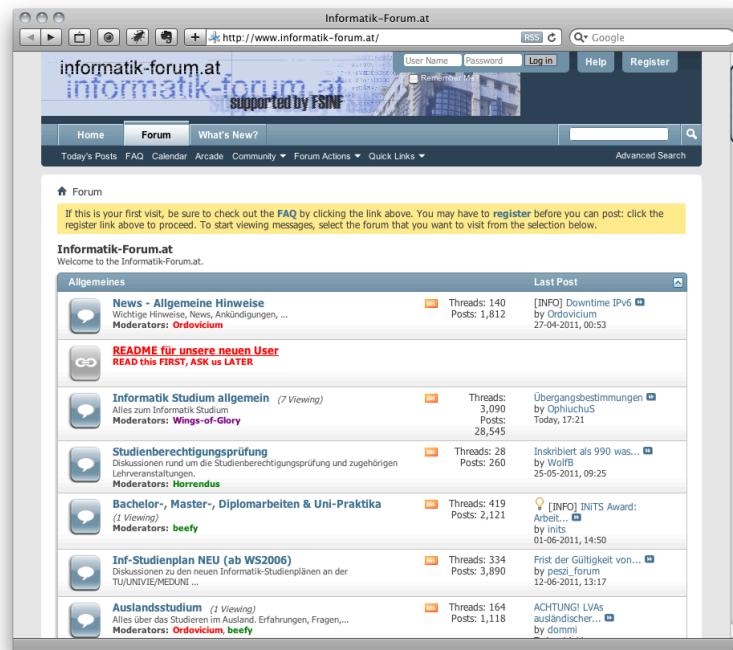


Fig. 11: Informatik-forum.at sub-forum overview.

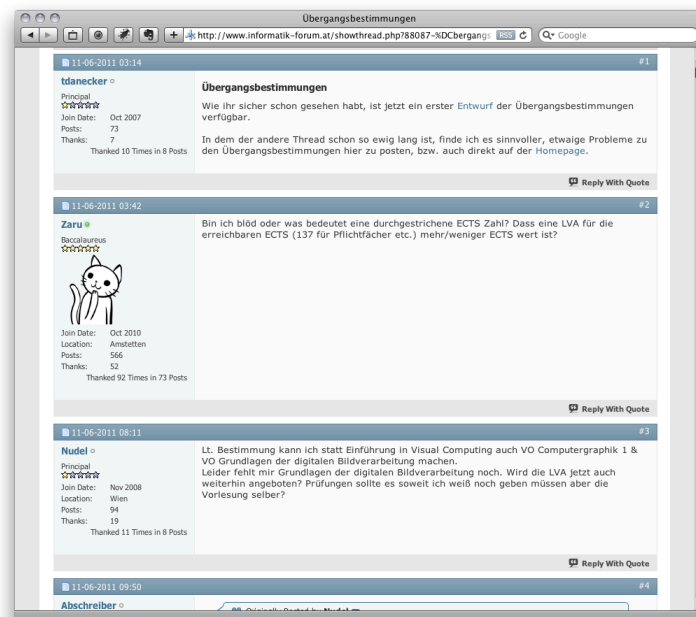


Fig. 12: Informatik-forum.at thread detail view.

IF has 59 sub-forums grouped in ten categories, all accessible from the main page (see Fig. 11). In this view, every sub-forum is listed with read/unread-icon, title, subtitle, moderator names, subscription buttons, thread count, post count, and title/user/date of the last post, with a

direct link to that thread. Clicking on the sub-forum title takes the user to the sub-forum view. Each sub-forum view shows all of the threads with title, author, date, reply count, view count, last post author/date and a direct link to that post (see Fig. 5 on page 51). Clicking on the thread title takes the user to the thread detail view. In the detail view, the user sees, depending on their settings, a linear view, threaded view or hybrid view. Every post consists of a headline with the date and number (per thread), a narrow column with username and user information, a wide column with the post content, and a bottom row with buttons: “Thanks”, “Report”, “Reply”, “Quote” and “Multi-Quote”. (see Fig. 12)

User information and credibility

The user information takes a considerable amount of space. Attached to each post are user name, a “status” name with stars, a user icon, join date, location (optional), post count, “thanks” given and “thanks” received. The “thanks” feature allows a user to say thanks to another user for a particular post, i.e. to mark a post as good. The user “status” is represented with special titles (usually community-specific and made up by the administrators) and stars and depends solely on the total number of posts, except moderators, who always have a special status. In a former version of IF (which presumably used an older release of *vBulletin*), the status was the only measure of “credibility”; the amount of participation, of course, if anything only indicates how dedicated one is to the community, not how much quality one’s posts have – yet even this is questionable as the ratio of reading to posting greatly depends on personality and other factors.

This, however, is remedied with the “thanks” feature, and the fact that the accumulated thanks given and received are displayed automatically establishes the credibility measure in two ways: First, how many commonly appreciated posts one has made, and second, how much one cares about the credibility system, measured by the thanks given. A user who ranks high in both fields, with reasonable proportions, appears as a user who both encourages and delivers quality in contributions. On some other sites, *vBulletin* also allows to use a “reputation” system, making it possible to give a post (and thereby its author) positive or negative points which are then displayed as a green or red bar below the name. IF’s “thanks” system is effectively a reputation system with positive ratings only and high visibility of the ones who thanked.

Quoting

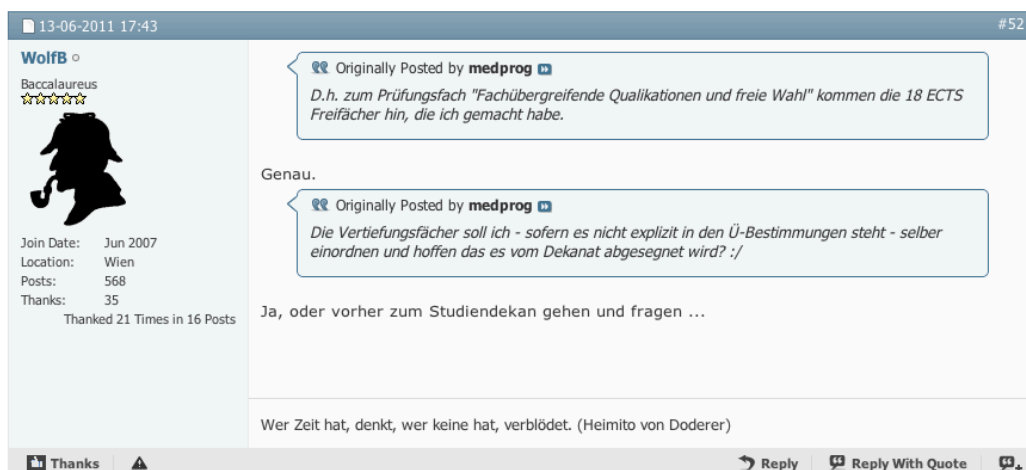


Fig. 13: Quoting with the source text split into multiple parts.

The quote-feature allows a user to start a reply to a certain post with the post's contents automatically included, marked in a special style via BB syntax (BB syntax is a reduced version of HTML formatting to allow bold text, colours, images etc.). "Multi-quoting" is a relatively new feature and allows several posts in the thread to be marked which are then automatically quoted with their full contents as soon as one starts a new reply. These functions are just convenient alternatives for the BB syntax "[QUOTE=username;postid] text [/QUOTE]"; with the syntax, however, it is also possible to split the quoted content into several parts and reply to multiple points made or questions asked in a systematic fashion, with the direct context always spatially adjacent.

Quoting is highly important for three reasons: 1) The large posts and (per default) linear view make it hard to follow conversation threads without quoting. 2) Multiple references can be made systematically and visibly. 3) "Display", the verbatim repetition of another's contribution as a way of providing acknowledgement in order to enable grounding can be implemented through quotes.

Reply structure

As mentioned earlier, vBulletin offers the choice between a "linear", "threaded" or "hybrid" view. In both the linear and the hybrid view, however, the posts themselves are lined up after each other and provide no direct cue to their parent. This, combined with the generous amount of

space each post has anyway, leads to frequent quoting, so as to give the reader enough context of the sub-conversation. Every post allows the user to “reply” or “reply with quote”. Both result in an activation of the “quick reply” form at the bottom of the page, as does a click on the “reply to thread” button right above this form. “Reply to thread”, however, causes a top-level reply to be initiated. The quick reply form provides buttons for basic formatting (in BB syntax), but also an option to “go advanced” which takes the user to a separate page with a wider array of formatting buttons, smilies and a preview of the response.

Editability

On the IF, users can edit their own posts at any time after they submitted it. Any edited post, however, is marked as such with the date of the last edit. This is an interesting feature, since we are not used to being able to change our statements after the fact. It means that any number of readers see the original and any other number see the edited version. In the IF, this is typically not a problem, but in one case⁸ it was used extensively. In this thread, a job posting caused disconcertment since the proposed pay was, as some argued, below the legal minimum. The original poster then reacted in an offensive way, further putting the others off. Reading the thread almost a year after it ended, one tends to get confused: The original poster edited their posts in almost all instances, in order to take out particularly offensive statements. Those statements, however, can largely be seen in the quotations by others. In this case, the removal of parts of contributions was, arguably, illegitimate, as, were it not for the quotations, a reader would be puzzled by the apparent overreaction of those who argued against the original poster. The development of the debate was therefore altered so significantly that subsequent posters were retroactively denied their claim for *truth* (see 2.1), that is to say the truth in form of the content of the posts to which they referred, rendering their responses inappropriate. The interesting thing is that, because of the nature of AOD, only the documentation of communication was, in fact, altered, since the participants had read the posts before they were edited.

As we have seen, editability may be useful, but can also cause problems. In *Moodle*’s forum module, posts are by default editable for five minutes, allowing the user to correct errors and

⁸ <http://www.informatik-forum.at/showthread.php?t=74808>

improve articulations that they might find problematic just after they posted, but preventing such retroactive obfuscation of one's own statements as described above.

User profiles, friends and private messages

BBSs typically offer the opportunity to see any other registered user's "profile" page and to send them a private message (PM). In the case of IF/vBulletin, a context menu that appears when a user's name is clicked offers links to both the profile and the message composition page. On the profile page, any personal information the user is willing to divulge is visible. "Befriending" a user is also available from there, as is a search for all of their posts and threads and an option to ignore messages from them. Profiles and friends create an opportunity to construct a "network" and to attach a little more than just a nickname to a contributor, again supporting credibility and situatedness (since personal details strengthen the connection to the "real world" which is, in the case of IF, quite important as the community is connected to a university programme in a particular city). Private messages allow communication beyond the "public" mode in which every message is visible to all, while limiting the exchange to the identities used in the forum, without introducing e-mail addresses, which one might not want to publish.

It is worth noting that Vienna University of Technology is a large institution, and computer science is its largest faculty (the largest by far in terms of students). There is no campus as such and no university-affiliated student housing. The common facilities are limited to canteens and some public computer labs. Aside from occasional events run by the computer science student representatives, community-building happens in and around individual lectures, many of which (at least in the undergraduate programmes) are held in groups of over a hundred students, sometimes up to five hundred. The IF is therefore a facilitator not only of discussion among students of different programmes within CS, but also of building and keeping a network. When one meets the people behind the nicknames in the forums "naturally", i.e. in a class or at a university-related event, both "identities" of the person support each other. Having the basic social networking features vBulletin provides accessible in the IF is therefore a good choice.

5.2.2 Slashdot: Complexity management

The already mentioned site *slashdot.org* has been a primary source for "geek" news for years and it is not uncommon that a news article gets over 500 comments within a couple of days. How can

this be displayed in the detail view without deterring the user from even beginning to read the posts? Slashdot uses the following techniques:



Fig. 14: Slashdot.org comments section.



Fig. 15: Slashdot.org comment visibility slider.

The basic layout is a nested view, i.e. all posts are indented according to their depth, and displayed immediately below their ancestor. It only displays a certain number of posts by default. If the user wants to read more, they have to click on a link labelled "load more". A part of the remaining posts is then loaded and dynamically attached to the page below the ones already displayed.

Slashdot uses a rating system for comments. Out of a pool of long-time readers and contributors who are online at a given moment, moderators are chosen who then have the temporary ability to rate posts. They can tag them as "insightful", "informative", "funny", "flamebait" etc. Positive ratings yield points, with 5 points being the highest possible score for a single post and -1 the lowest. Every user (registered or not, moderator or not) has controls on the

thread details page with which posts can be filtered according to their rating. The controls consist of two sliders which correspond to thresholds for displaying posts in their “full” form, in an abbreviated form (only the author name, first line and rating) or to hide them completely and only display an indicator on how many posts are hidden, where appropriate. A given setting might cause all posts with a score of five to be displayed in their entirety, all posts with a score of three or four to be shown in abbreviated form and all posts with a score of three or lower to be hidden. If a post is fully displayed and is not a top-level post, its topmost ancestor is fully displayed, too, regardless of its rating. (See Fig. 14 and Fig. 15: Slashdot.org comment visibility slider.)

By default, the order of top-level posts on the thread detail page (and therefore the order of the subtrees) appears to be determined by the score of sub-posts so that those subtrees with the highest number of highly-rated and fully displayed posts appear at the top of the page.

This is clearly a sophisticated system, and since several new articles are posted every day and an article may get anything between zero and a thousand comments in the short term (i.e. within a few days), it is a viable way to keep those sub-discussions visible that have been found valuable by experienced users.

5.2.3 StackOverflow: A community of practice

The screenshot shows a StackOverflow question titled "I'm struggling to create a regex expression in Javascript to match values between 5pt and 30pt". The question has a score of 0 and was asked 24 minutes ago by user 'tou' (639 reputation, 83% accept rate). It has 6 answers. The top answer, by 'Andrew Curioso' (704 reputation), has a score of 5 and was edited 12 minutes ago. The answer provides a regex: `/\b([5-9]|[1-2][0-9])pt\b/` and explains that the '30' is the odd one out because '31' would be invalid. It also includes an edit: "Added a boundary in there so it doesn't match things like '35pt'". Below the answer, there are two comments: one from 'Bryan' (17 mins ago) stating the regex might match '35pt' or '130pt', and a reply from 'Andrew Curioso' (12 mins ago) thanking Bryan. A final comment from 'Andrew Curioso' (9 mins ago) mentions the use of lookaheads.

Fig. 16: Detail view of a question on StackOverflow.com

StackOverflow.com is a platform for the discussion of programming problems and questions. Every thread is initiated by a specific question: Help with bugs someone cannot fix or with errors they do not understand, advice on how to achieve a particular program behaviour, feedback on the quality of a software design decision. Questions rank from beginner's issues to highly specific problems with certain APIs. In the detail view (see Fig. 16), an answer can be given. Both questions and answers can be commented on, and both can be voted up or down. The author of the question can mark one answer as the "accepted" one, thereby signalling which response was the most useful to them. This is then always listed as the first response, followed by the others ranked by votes.

StackOverflow uses a system of reputation points. A new user starts with one point; positive votes on one's contribution or having one's answer accepted raises one's reputation by a set number, negative votes lower it – but *giving* a negative vote also lowers one's score, albeit only by one point. Thus, downvoting should only be performed by those who find the case important enough to "sacrifice" a little bit of their own reputation. Also, the more reputation one gains, the more rights one enjoys: With a single reputation point, one cannot comment on others' contributions or downvote. Progressively, one gains the right to vote on closing a question, to edit others' posts and to create new tags, until, with thousands of reputation points, one's rights are essentially those of a moderator.

Interdependability

StackOverflow is a great example of a platform for a community of practice. The common denominator, programming, allows a large user base with a common base and very different special knowledge (*interdependability*), but the discussions are strictly kept within the topic of programming problems, and questions such as "What is your biggest fear as a programmer?", relevant as they may be for a community (as discussed in chapter 2.4.5), are quickly closed down. This is also an effective measure against trolling. Shirky (2008, pp. 136f) describes how vandalism is unrewarding in Wikipedia because too many people care enough about it that most acts of serious vandalism or misinformation are undone within minutes or hours. The same principle applies to *StackOverflow*: It is so valuable as a tool for professional exchange, that even well-meant attempts of introducing a subjective and potentially emotional topic are halted before they attract too much attention.

Accountability

When sharing knowledge and factual information is the central goal of an AOD platform, functions that facilitate learning directly from each other (and not only through reflection on the discussion and gradual growth of the common ground) are important, and being able to hold contributors accountable for their posts is crucial.

As a user, one takes on a nickname that provides anonymity, but reputation is accumulated on this name and as long as one cares for the reputation points, one is directly *accountable* not only for respecting the etiquette of the forum, but also to provide contributions that have some quality. To further encourage appreciation of the reputation systems, some events (such as getting a certain number of views on one's question) result in achieving a "badge" associated with one's signature and profile, such as "notable question", "guru" (for a much-appreciated answer) or "necromancer" (for a good answer to an old question). On top of it all, one can set a reward for questions that are particularly hard and important; the reward consists of reputation points the asking user transfers to the user who contributed the answer which the asker accepted.

Peer assessment & peer facilitation

It is crucial that it is very rare that one can earn points with mere opinions. Hence, only by asking "good" (not obvious) questions and sharing considerable knowledge, one accumulates reputation. Only those will become facilitators who are also competent in the subject matter (which is, of course, a very large field). The result is a self-organising community in which those who care most (and have sufficient knowledge) have the most power.

The evaluation of one's "quality" in terms of professional knowledge is performed by other users. Self-damage inflicted by downvoting, however, along with the daily limits on reputation gains and some other mechanisms should ensure that appropriate positive assessment is encouraged, negative assessment is discouraged, and everybody can "grow" rather easily.

5.2.4 Truthmapping: An attempt to design for argumentation

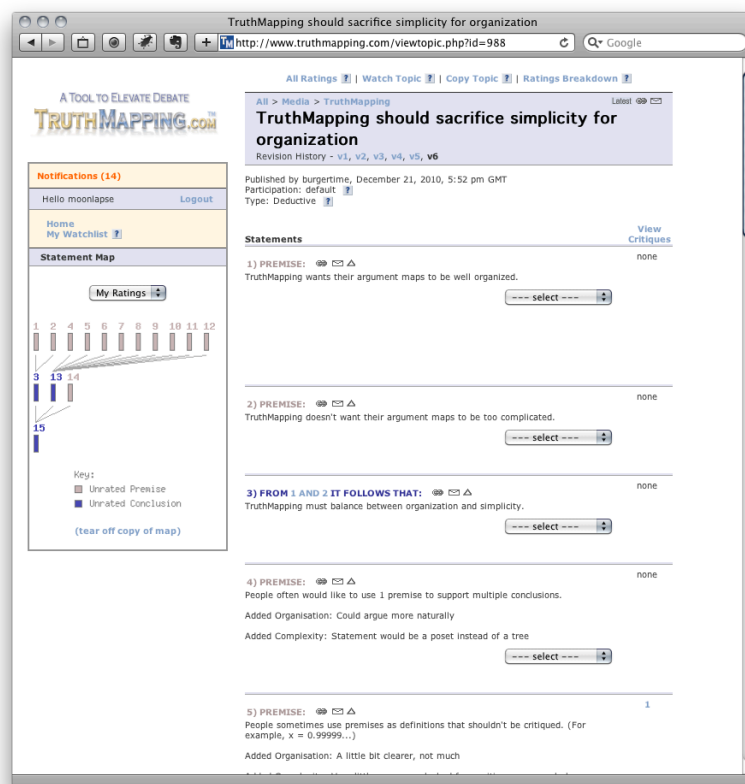


Fig. 17: Detail view of an argument on Truthmapping.com.

Truthmapping.com (henceforth TM) is a site on which a new, experimental discussion layout is used. It claims to provide a “focused, rational method for adversarial discussion that overcomes the limitation of standard message boards, e-mail and even conversation.” (Truthmapping 2011) It proposes to solve the following problems:

1. *Losing focus of the core arguments because of long sub-discussions or intentional or unintentional digression.*

Off-topic sub-discussions should not command too much attention, but may dominate a conversation thread, especially if sub-discussions are not visible as such, as is the case in a linear view, e.g. that of *vBulletin*.

2. *Filling up the space with mutual clarifications instead of only using them to promote the arrival at the realisation where the actual disagreement or misunderstanding lies.*

Pena-Shaff & Nicholls (2004) report that in a case-study of student communication on a BBS, they classified 44% of all contributions as “clarifications”: “Identifying and elaborating on ideas and thoughts”. Truthmapping proposes to largely hide the process of such mutual elaboration after the fact and only show the results.

3. *Dominating a discussion by a high quantity of contributions, regardless of the quality.*
4. *Assumptions are often hidden.*

Making assumptions visible and thus accelerating and supporting the establishment of a common ground contributes to a productive discussion.

To solve these problems, TM uses a system of logical deduction or induction. Only the deduction type shall be described here, since the induction type is very similar. When one creates a topic, one has to dissect one’s statement into premises and deductions from those premises. Every deduction clearly references any number of other deductions or premises. Each deduction or premise can then be individually agreed or disagreed with and criticised by other users. The critique can then be answered by the thread author with a rebuttal. Both critique and rebuttal can be revised multiple times by their respective authors, so that in the end every deduction/premise can have a list of critiques, every critique has a list of revisions, every revision has a list of revisions of its rebuttal. By default, only the very latest revisions of each are visible, but one can view any revision by clicking on links in the critique/revision container. The deductions/premises are numbered and their connections are visualised in a minimalistic graph left of the content area. As for the induction type, it is just modelled as deduction with an added “likelihood” of each logical step.

There are several problems with the TM approach. First, it only really supports a certain type of discussion: The systematic debate of an unambiguous statement that can be formulated in terms of premises and deductions. Take one of the ever-present open debates about abortion as an example. A statement such as “abortion should be legal up to X months of pregnancy” can be neatly dissected into premises and deductions, each of which can then be argued about in critiques and rebuttals. However, an open-ended question such as “in which cases should abortion be legal?” is impossible to force into the TM framework. In fact, the whole debate only has chances to be productive if the thread author has a theory that is consistent for him- or herself and if they are willing and able to expose all premises and logical steps to be criticised. This is a

fundamentally different approach than the process described in 3.2.3: *Topic initiating* is almost impossible since participants have to work with the structure of the thread author's argumentation, before they can even discuss whether that is valid. Since all discussion is bound to certain statements, it is also difficult to summarise or build a different theory with multiple steps. In general, the strict logical framework enforced on every discussion on TM may hinder conversation on all but a few topics. TM is not very active, and many of the topics it has are so poorly constructed in their logical steps that no one even bothers to reply.

Second, the user interface is detrimental to the experience. The separation of graph and statements in the reader's view precludes *direct manipulation* (Apple 2009) and makes the graph a curious oddity rather than an actual help. When entering statements for a new topic, there is a dropdown list next to each premise/deduction to select which other premise/deduction it supports, identified by number. As soon as one such support selection is made, however, the page reloads and the numbers of the premises/deductions have *changed*. For example, to have statements A, B and C support D, one might have to select #4 for A, #2 for B and #3 for C, because D is #4, then D is #2 and finally D is #3. This violates the principle of *stability* according to which elements should not change their position or identifying characteristics for no apparent reason (Apple 2009). Similarly, many of the page reloads that disrupt the user experience (Scott & Neil 2009) would not be necessary if TM redesigned their page to follow the "Web 2.0" principles.

Despite all the problems, an AOD platform following the TM approach could find a place in e-learning. If the problems outlined above could be solved, it could be employed to collaboratively discuss and dissect an argument for a particular policy, without having to compromise its limitation to complete, closed statements as a starting point.

5.3 Design Issues

We have seen the general structure of AOD interfaces and analysed in detail specific platforms that are focussed on particular types of discussion. Now, some design strategies shall be examined that can be found in a variety of platforms and that address the greatest common challenges of AOD systems.

5.3.1 Attention and Filtering

Most AOD platforms depend on a “critical mass” to function, i.e. if there are not enough active participants, the periods between contributions to a particular topic grow too long and people lose interest. If the mass is great, however, the volume of contributions quickly surpasses an amount manageable for any user with a limited time budget. The user’s attention has to be directed where it is most likely to find something interesting, and the user must have the tools to filter information conveniently, i.e. to increase visibility of items matching a particular criterion and decrease that of the rest. If these tools are not available, problems of complexity and time management grow.

There are different approaches to reduce the number and size of items a user has to process to find the interesting information. In cultures that read from the top left to the bottom right, for example, placing items at a position above and/or to the left of other items gives them primary attention. In addition, the limited space of a computer screen makes it possible to show only so many items without requiring the user to scroll. Another approach is colour coding. Stronger colours make items stick out, but most colours have natural or cultural associations. Shneiderman & Plaisant (2004, pp. 510ff) point out that red might signal “danger”, “stop”, “hot”, financial loss or “on” in different contexts; the designer should be clear about the primary associations users will have with a colour. It is also necessary to consider colour-deficient users and to be consistent in one’s colour-coding (ibid.). Grouping data, applying labels, lowering information density and adjusting information to a grid structure improve search speed, i.e. make it easier to filter relevant from irrelevant information (ibid., pp. 494-499).

In vBulletin, threads are ordered top-down after the date of their last post, so the most recently active threads are shown first; however, the user can click on any of the column headers “title”, “thread starter”, “replies”, “views” and “last post by” to cause the threads to be ordered by the respective information; ascending and descending order is switched with a second click on an activated header. This is *consistent* with what is common in most desktop applications that allow the display of tabular data, most notably e-mail programs (because they are similar to the BB in their purpose and structure); consistency with standards and with expected behaviour is essential to the user experience (see Shneiderman & Plaisant 2004, p. 74; Norman 2002, pp. 200-202; and Apple 2009).

“Hot” threads in vBulletin have a red envelope icon to their left, although it remains unclear how a thread qualifies as hot – presumably a measure of views and replies. Unread threads have an icon with multiple envelopes; the difference to the read threads icon, however, is very subtle. Moderators can mark threads as “sticky”: Such threads remain on top of all others, regardless of the last post date, and have a bright red “[sticky]”-label in front of their title.

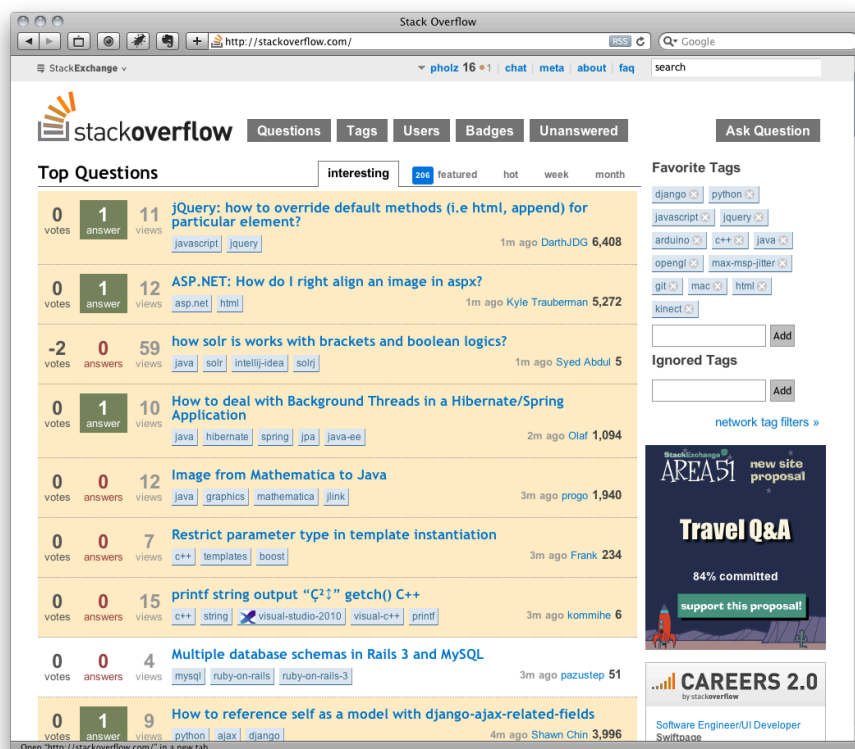


Fig. 18: Visual cues on Stackoverflow.com that help the user filter for the most relevant items.

On *StackOverflow*, several coding and filtering mechanisms apply at once. First, tabs on the top allow to view all threads by date (like in vBulletin), but since there are many new threads created every minute, there is also a “featured” tab (only threads with reputation “bounty”), and “hot”/“week”/“month” tabs, showing the threads with some aggregate measure of most votes, answers and views of, respectively, the current day/week/month first. On top of that, unanswered threads get a big red badge to the left of them while answered ones get a green one (with a yellow number if an answer has been accepted). Finally, one can define “my tags”: A web application developer might add the tags “html”, “javascript”, “jquery”, “python” and “django”, for example, designating various programming languages and frameworks. All items that have tags which are

among the user's "my tags" get a pale yellow background colour in the overview, instead of the standard white background. Thus, it is easy to quickly find questions that one is more likely to be able to answer or relate to. (It is also possible to manually filter by tag or, in the "unanswered" section, to see only questions with tags that one is observing in "my tags").

The screenshot displays the CIPD.co.uk forum interface. At the top, there are three tabs: 'Featured discussions', 'What's new', and 'Guidelines'. Below these is a table of featured discussions with columns for 'Topic' and 'Replies'. The table lists various HR-related topics with their respective reply counts. To the right of the table is a sidebar with a 'Renew today.' button and a 'Popular keywords' section. The keywords are listed in a vertical stack, with some in bold and others in a smaller font.

Topic	Replies
London 2012 absence / volunteers	10
Firms to shun former public sector employees	34
Women in the Boardroom - Lord Davies Report	25
Using personal smart phones for work emails	6
Next Generation HR: What's influencing your L...	13
Public Holiday - Royal Wedding	119
Sector Specific HR Groups	6
Draft new CIPD Code of Professional Conduct -...	47
When does restructure become redundancy	26
Costs of defending an employment tribunal	44
Has the DDA and EAT Gone too far in protectin...	41
First aider payments	7

See more: [View all discussions](#) : [All subject boards](#)

Popular keywords

- absence** disciplinary
- Discipline and**
- grievances**
- dismissal**
- Employment**
- Law at Work** HR
- trends Incentive pay and bonuses
- Management development
- Maternity and parental**
- rights** Occupational Health pay
- structures Personnel records
- Policies and**

Fig. 19: Cipd.co.uk – visual filtering mechanisms.

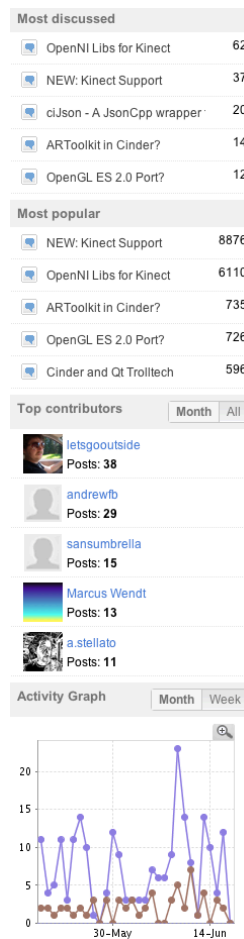


Fig. 20: Activity summary in the Cinder forums.

Information useful for filtering can also be spatially separated from the main overview page. On the website of the Chartered Institute of Personnel and Development (*cipd.co.uk*), a small box containing the latest forum topics with a visual indicator of their reply count provides visual cues while a box next to it shows a “cloud” of popular keywords (see Fig. 19). In the forum for the creative coding framework *Cinder*, several boxes right of the main content area list the most active threads, the most viewed threads and the most active contributors, and show a graph of recent forum activity (see Fig. 20).

In the already described cases of *Slashdot* and *Gizmodo*, certain contributions may be hidden by default and the user must take action to make them visible. This pattern (albeit described with respect to controls rather than content) is called “progressive disclosure” by Apple (2009) and Scott & Neil (2009), and “divide and conquer” by Norman (2002). In general, it is the strategy to automatically show those controls/items that are most likely to be used (at all or at first) and to provide options to show different groups of other controls on demand, to reduce visual

complexity, but without having to either get rid of the additional content/controls altogether or, in the case of controls, use contrived mappings.

5.3.2 Categorisation

Tags, as mentioned earlier and in heavy use at *StackOverflow*, are a common mechanism for filtering in a mass of user contributions. *Flickr*, *delicious.com* (a social bookmarking site), *CiteULike* (a social reference management site) and various other community sites allow users to tag their contributions, be it photographs or bookmarks. Tags can be more or less popular and have related tags (i.e. other tags that are applied to the same items rather often); the result is a semantic network that has been called “folksonomy” (Smith 2004), a portmanteau of “folk” and “taxonomy”. Such folksonomies are imprecise, flat and likely to contain many synonyms as separate tags (Mathes 2004), but leverage the power of the community to structure content of a multitude that could not be handled by centralised categorisation.

While tags are essential to most content-sharing platforms, discussion platforms have not adopted them unanimously. *StackOverflow* uses tags because nobody is interested in every programming language or API present on the platform. On *commentables* such as *slashdot* the articles that act as threads are tagged by the authors, but that is not necessarily tied to the “commentability”. IF allows users to tag threads - but nobody does, because there is already a multiple-layer-deep categorisation in place (a new thread about the lecture class on “Fractals”, for example, would have to be posted in “Vienna UT -> Master Programs -> Courses -> Fractals (Lecture)”, a job offer in “Off-Topic -> Jobs”). In this case, pre-defined categorisation makes sense. Occasionally somebody posts something in a sub-forum that does not match the topic of their thread. In such a case the moderators typically move the thread to the correct sub-forum.

“Categorisation” according to subject, however, is not the only type. IF offers a “prefix” to every thread: In the sub-forum about general questions relating to the computer science program these are *search*, *info*, *question*, *suggestion* or *problem*; in the off-topic sub-forum instead of the last two we have *discussion*, *help* and *other*⁹. The thread is then prepended with a little icon that represents the type of issue chosen, or with the textual label if there is no corresponding icon, in the overview. The forum also allows to make polls with attached threads, which have their own

⁹ my translation of the German equivalents, P.H.

icon. It is hard to say whether such classification helps with filtering, but marking one's thread as an invitation to discuss or a question might reduce ambiguity by communicating more clearly the intention of the thread author.

5.3.3 Sub-discussions and references

If the original post of a thread is regarded as the “root”, a longer discussion will invariably take the shape of a tree growing from that root, be it shallow and wide or narrow and deep. While patterns to tackle the complexity of the sheer amount of topics and replies have just been described, patterns that help navigate the semantic connections within a thread are no less important, especially if the discussion is a serious debate rather than a mere accumulation of one-off comments (such as on *Flickr*).

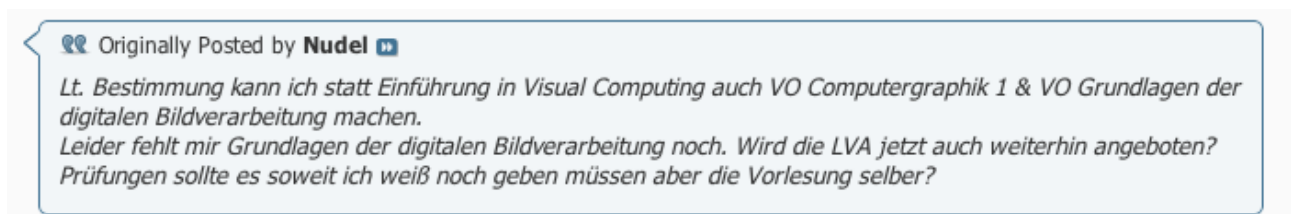


Fig. 21: A quote in informatik-forum.at (using vBulletin).
The button next to the cited author's username links to the original post.

In *vBulletin*, the inserted quote automatically gets a button next to its label (see Fig. 21) that takes the user who clicks it to the referenced post. This is necessary in long sub-discussions of mutual quoting because, unlike in e-mail conversations, a quote within the quoted post is automatically removed, to avoid the accumulation of nested quotes and, as a consequence, endlessly long posts even if the actual reply is rather short. On *gizmodo*, the “@nickname” reference is automatically inserted before one's reply text and also acts as a link to the referenced post.

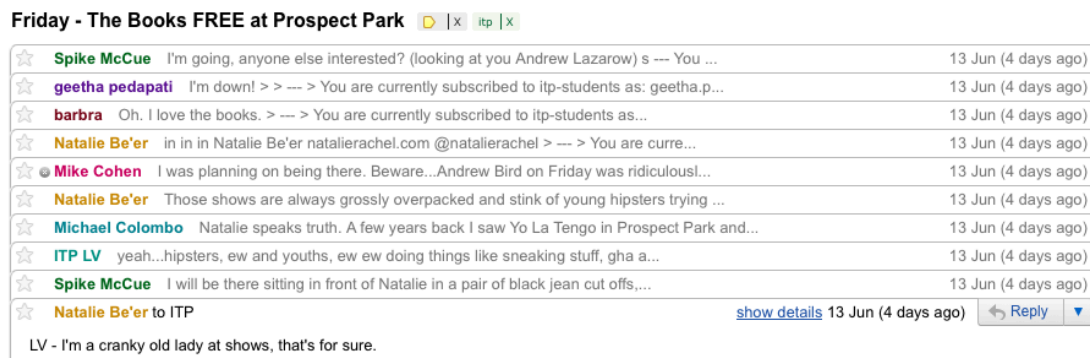


Fig. 22: Gmail stacking read mails to provide context while minimising space requirements.

There are also systems that autonomously structure the display of conversations. The webmail interface for *Google Mail* (*gmail.com*) recognises mails that are follow-ups to earlier correspondence by the common “Re:”-tag prepended to the original subject line and groups all mails of one conversation into one “thread”. When the user opens the detail view, the latest message is displayed fully while the older ones are only visible by their subject line and date, in what looks like a stack of sheets piled up below the latest mail. They can be “maximised” by clicking on their subject line (Fig. 22). Apple Mail provides this functionality in a very minimal way: When a message of a conversation is selected, all other messages of the same conversation are highlighted in an unobtrusive blue.

5.3.4 Credibility and ratings

3 Answers

activeoldestvotes

▲

220

▼

✓

First, you have to learn to think like a Language Lawyer.

The C++ specification does not make reference to any particular compiler, operating system, or CPU. It makes reference to an *abstract machine* that is a generalization of actual systems. In the Language Lawyer world, the job of the programmer is to write code for the abstract machine; the job of the compiler is to actualize that code on a concrete machine. By coding rigidly to the spec, you can be certain that your code will compile and run without modification on any system with a compliant C++ compiler, whether today or 50 years from now.

The abstract machine in the C++98/C++03 specification is fundamentally single-threaded. So it is not possible to write multi-threaded C++ code that is "fully portable" with respect to the spec. The spec does not even say anything about the *atomicity* of memory loads and stores or the *order* in which loads and stores might happen, never mind things like mutexes.

Of course, you can write multi-threaded code in practice for particular concrete systems -- like pthreads or Windows. But there is no *standard* way to write multi-threaded code for C++98/C++03.

13-06-2011 23:57

#67

peszi_forum

Dipl.Ing
★★★★★
Join Date: Jun 2004
Location: Vienna
Posts: 1,599
Thanks: 5
Thanked 41 Times in 38 Posts

Hallo,

Originally Posted by ma_inf54

Hallo, peszi_forum
Als Bsp. für die Mathe2 ÜE bekam ich für die 2std/4ECTS (TU Studenten 3 ECTS) oder für Datenmodellierung 2std/ 2ECTS (TU studenten 3 ECTS). Mitbeleger war ich seit 2009. Bin jetzt aber ordentlicher TU Student. Zeugnisse sind unter 521 ausgestellt - ist das informatik Studium an der Uni Wien. Soweit ich mich informiert habe, brauch ich keine Anrechnung für diese LVA's die ich an der TU bestanden habe, und die LVA's vom 521 Studium habe ich schon angerechnet bekommen. Sprich ich kann sie alle sammt für den Bakk einreichen, nur halt das ich die STD*1,5 rechnen soll.

@ma_inf54: Du hast Deine Frage glaube ich selber beantwortet bezüglich ECTS selber beantwortet. Nehme einfach den Formel x SWS*1,5=y ECTS.

Reply With Quote

The Following User Says Thank You to peszi_forum For This Useful Post:

ma_inf54

++++++ THOR ++++++ + 1

17.06.2011 08:11

permalinkantworten

bewertenmelden

ich mag ja altmodisch erscheinen

aber ich spiele ein spiel schon seit 8 Jahren auf dem PC (Warcraft 3). Wenn die Balance und das Gameplay stimmt, wird es zeitlos.
Neuere Titel hab ich auch schon gekauft. Zuletzt Battlefield und Call of Duty. Einen Tag durchgezockt und fertig war die Sache. Wunderschöne Grafik, aber der Langzeitpass ist nicht zu finden.

Fig. 23: Rating mechanisms on *StackOverflow*, *informatik-forum.at* and *derstandard.at*.

On *StackOverflow*, we have seen how contributions can be voted up or down, and how these votes are translated into reputation points for the receiver (and negative points for someone giving a negative vote). The contribution's rating is represented by a number in large type. In IF, this translation is more direct, with the number of total "thanks" displayed next to a user's avatar and information; but below the post everyone who "thanked" for this post is listed by username, personalising the rating much more. On *derstandard.at*, posts can be rated as good or bad, but the

rating is only reflected as a green or red bar next to the post; the raters are not visible by username, and the accumulated ratings for an author are not visible anywhere. The intended effects for the communities are: On *StackOverflow*, the focus on objective, technical answers makes it irrelevant who voted for or against a particular answer as long as they are “qualified” through the reputation system. On *derstandard.at*, discussions are in very different subject areas and very opinion-heavy, while the user base is hardly a community and has few things in common, beyond readership and internet use – hence, visually marking valuable and invaluable posts helps filter through the contributions, but a user’s “credibility” is not so important. In IF, the heavy community aspect makes both a highlighting of valuable posts and valuable authors beneficial, and seeing who gave the “thanks” to one’s post might actually be of relevance, since there are many well-known long-time contributors whose appreciation is meaningful, and possibly even users who one might know from “real-life” situations. In summary, the rating system is always matched to the intents and purposes of the AOD platform. (See Fig. 23)

5.3.5 Feedback and the Gulf of Evaluation

It is not uncommon to find a message in some AOD system posted twice, for no apparent reason. The usual cause for this – unless the author is a troll or spammer – is that the author clicked on “submit” in the reply form, and then the submission process either reported it had not succeeded when in fact it had, or took so long without providing any indication of its process that the author chose to retry, not knowing that the original submission had succeeded. While the former case is a clear program error, the latter case is best described as too large a “gulf of evaluation”. Donald Norman (2002, p. 48) analyses the process of user action as follows:

- Forming the goal
- Forming the intention
- Specifying the action
- Executing the action
- Perceiving the state of the world

- Interpreting the state of the world
- Evaluating the outcome

If the last step, the evaluation of the results of one's actions by the user, differs too greatly from the actual system state, what Norman calls the *gulf of evaluation* is too large. In the case of the double-post, the system did not give the user enough or the right information to evaluate the submission process as either "successful" or "still working, with a chance of success even if you cancel the process by starting a new one". The way to bridge those gulfs is to provide unambiguous feedback whenever possible. "Visibility of system status" is also Jakob Nielsen's first "heuristic" for user interface design (Nielsen 2005), followed by the demand that the system speak in terms understandable to the user, i.e. detailed technical feedback is useless if users cannot be expected to be able to interpret it.

On *derstandard.at*, as soon as a post is submitted through the pop-up reply form, the message "your post was submitted and will soon appear on the page" is displayed. This is necessary because it does take a few minutes for the new contribution to be listed in the comments section, for reasons not disclosed by the website. If the message was not there, users might think that something went wrong and try to resubmit their contribution. If something does not work, feedback is equally important: On *StackOverflow*, if one does not have enough reputation to vote up or down, one can perform the action by clicking on the up/down buttons above and below the vote number, and the vote changes, as if it had worked, but then an overlay pops up explaining that one cannot vote yet, and the action is reversed. This way, "modelessness" (Apple 2009) is implemented, i.e. the user is not prevented from doing something, but since the action is not allowed in the current situation, the result is indicated, but reversed and an explanation for this behaviour is provided. The user cannot do something, but receives an explanation why that is the case and is also shown what *would* happen if they did have the permission. All this contributes to a better "conceptual model" (Norman 2002, pp. 12f) of the system in the user's head, reducing errors and frustration.

5.3.6 Responsiveness and contextual tools

While *derstandard.at* makes do with pre-“Web 2.0”-functionality in the comments section, *StackOverflow* uses AJAX to increase responsiveness of the system, reduce interruptions and implement techniques such as the modelless self-explanatory unavailability of a function just described. Scott and Neil (2009) relate the story of the social news site *digg.com* which used to have a traditional, non-AJAX process of “digging” a story (marking a story as interesting). When they switched to a one-click “digg” via AJAX in 2005, activity increased enormously. The ergonomic principle called “Fitt’s law”, originally proposed in 1954, states that “the time to acquire a target is a function of the distance to and size of the target.” (Scott & Neil 2009) Putting tools close to the context in which they are needed makes them easier, more efficient and more attractive to use. If they are also minimally disruptive – i.e. if you can “digg” a story without being directed to another page, which would disrupt your reading/surfing experience – they are even more attractive.

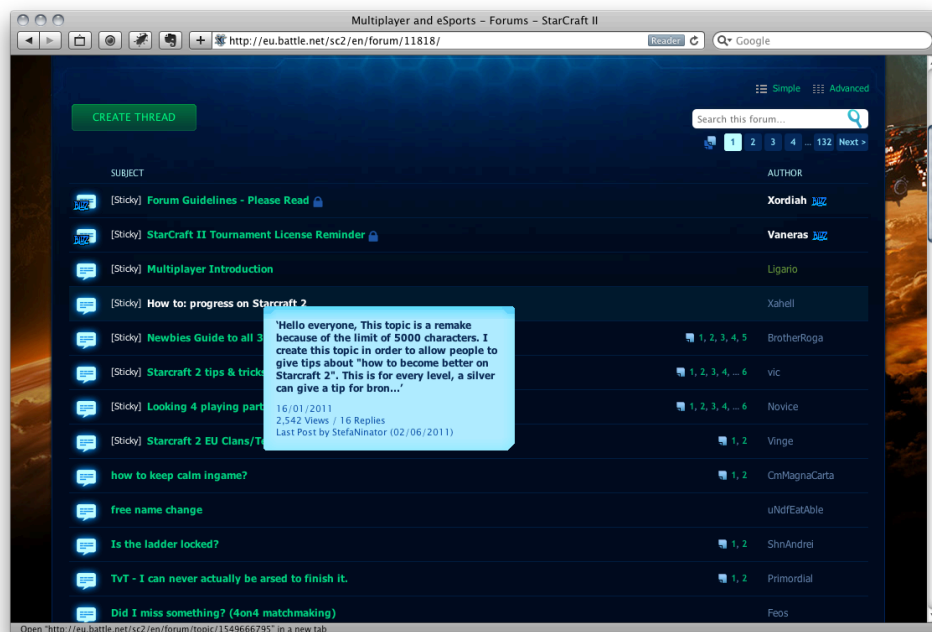


Fig. 24: Thread contents pop-over in the *battle.net* forums.

Contextual information paired with progressive disclosure can be observed, for example, in the online forums of the *battle.net* platform, an account management and community system run

by the computer game developer Blizzard for their games. If the user positions the cursor on top of a thread title, a pop-over containing the first few lines of the initial post in the thread appears (Fig. 24). The pop-over also shows the creation date, date of last post and reply and view count; most of this information is not visible in the standard thread overview. This results in a clutter-free view that only shows the most essential information, with details provided effortlessly if the user is interested in a particular item.

5.3.7 Visual structure and layout

As we have seen, most AOD systems use a tree (with an optional maximum depth) for organising the posts, even if in the display it is flattened, as in the “linear” view of *vBulletin* or *gizmodo*’s comment section. *vBulletin/IF* gives each post a generous amount of space: Horizontally, it is about 80% of the window width, but at least about 600 pixels; vertically, it’s as much as it takes, but at least about 300 pixels. That means that on a typical monitor resolution of 1440 x 800 pixels and the default browser zoom setting, it is virtually impossible to see more than three posts at the same time, even if each one only contains a single line. The result is that the posts are either scanned from their author / first words tagline only (in tree or hybrid mode) or in a linear fashion (in linear mode), with the quoting (which consumes space of its own) always presenting a back reference to the “parent” content in the sub-discussion.



Fig. 25: Moodle's default thread view.

Moodle's forum module tries to combine the advantages of both display formats in its default view. The posts are displayed fully, with indentation corresponding to depth, a low minimum height and a width that extends to the right window border. User information is stripped down, however, and it is very difficult to get an overview of the sub-discussions. It is not possible to "collapse" them or to see at a glance how many top level posts have been made. (Fig. 25)

Essentially, the tree-like structure of AOD threads is the same as a file system structure. One current standard approach of GUI-based file system navigation applications such as the Windows Explorer and Mac OS X Finder is to present all the files and folders of a folder in a list, with the option to either open a folder in a new window (or the same window, replacing the current view) or to expand it, with indentation indicating the depth increment. Shneiderman & Plaisant (2004) call this mode of presentation *expanding menus*. Such menus preserve the context while also providing detail (i.e. the contents of the next layer), at the expense of overview. Moodle uses this structure, but all its expandable items are always already expanded. Slashdot uses this structure, too, but its expansion mechanism is tied to the ratings mechanism. The overview issue is exacerbated in AOD systems because content qualifies as an additional layer of detail that in itself asks for a compromise between overview and detail information.

In all AOD platforms I investigated I have found either a linear structure with only semantic depth indication (like quoting in *vBulletin*) or some approach to the expanding menus format.

5.3.8 Pace and granularity

Due to longer intervals between participants' turns and a longer time to compose a message, the pace of AOD is rather slow compared to synchronous online discussion or face-to-face discussion. If the "reply tree" is broad and/or deep, the slow pace can be a problem because one cannot progress down the tree fast enough. Dix et al. (2003, p. 502) identify several *coping mechanisms* that exploit the large "chunk size" of AOD to progress faster:

The first is *multiplexing*: A participant may want to respond to messages in multiple branches of the tree. If the view employed is nested, this is possible directly. If the view is linear, they multiplex several messages into one. This is a form of *multiple references* (see chapter 3.4.2), but not the only one: It should not be confused with using multiple references to *synthesize* information from several branches.

The second coping mechanism is *eagerness*. A participant may expect a certain response to their contribution with some probability, or a range of responses. This may also go down several levels of the tree. Take the following possible mail or text message: "Let's meet at X for lunch today. If that's inconvenient for you, we could also meet at Y. If today is bad, what about Wednesday? Z can, of course, come along too if she'd like to." Every sentence is an anticipation of a particular response. In a face-to-face discussion, the speaker would have waited for the other's response after each sentence. If they did that with e-mail, the exchange might require several messages each, uneconomical for a more or less spontaneous arrangement. Since the likely replies are within a limited set of possibilities (assuming the recipient is not generally opposed to meeting the speaker), the speaker can reduce the amount of messages exchanged by anticipating most of the likely responses and providing answers in the form of alternative suggestions.

While multiplexing allows a participant to respond to a *breadth* of contributions in one go, eagerness can collapse the *depth* of one or multiple child branches of the "eager" message.

5.3.9 Social Presence and synchronicity

Social presence is “the salience of the other in a mediated communication and the consequent salience of their interpersonal interactions.” Short et al. (1976, cited in Rourke et al., 2001) Social presence is largely determined by the way participants communicate in an AOD, but also by specific tools, such as emoticons, which can compensate for the lack of nonverbal communication. Avatars are significant for social presence, even if they do not show a picture of the “real” user: They provide an opportunity of visual identification. Avatars are a part of many AOD systems. Of the ones mentioned, *IF/vBulletin*, *Moodle*, *StackOverflow*, *gizmodo* and *battle.net* allow avatars. Users can usually upload any image they want. Typically, where one’s real name is visibly associated with the online identity and/or where the community is closed (i.e. it is known who has access to the forum, such as in a *Moodle* course or on *facebook*) people are much more likely to upload real pictures of themselves.

Increasingly, AOD systems have been trying to blur the boundaries between synchronous and asynchronous communication. Social presence is arguably higher if one can infer someone’s actual presence on the website. Some forums include an indicator that informs whether a given user is currently online (or was online at the time the page was loaded or last refreshed). *IF/vBulletin* features a “chat box” on the main page, which is an embedded chat area that behaves like an Internet Relay Chat channel or an Instant Messaging session. This supports the community, as it is commonly used for very personal and “off-topic” conversations. Users who are online in IF are also listed by their usernames at the bottom of the page. All these mechanisms increase the awareness of other users: When they are imagined as actually surfing the forum in this moment they seem to be closer than when they are only noticeable by a contribution that appeared overnight. This way, perceived social synchronicity (and hence proximity, even if only in the temporal sense) can be arranged with a discourse structure that bears all characteristics of asynchronicity.

An interesting attempt to merge synchronous and asynchronous online communication is *Google Wave*. The premise of the project was that users could create a “wave”, a session between multiple users that behaves like an Instant Messaging session in that it is synchronous; in fact, it is even more synchronous since users see other users type their contributions live. A wave also features indented replies, editing of others’ contributions (like in a wiki), private replies and media sharing. Most importantly, waves are persistent, unlike IM sessions that are, if at all, only

viewable in the shape of “logs”. Hence, a wave leaves it open whether it is used as an AOD system, a chat/IM application, a sort of informal wiki or a way to share media content. This openness, perhaps, led to its demise: *Google Wave* was shut down as a standalone service before it ever made it out of beta status.

6 Discuss. An experimental framework

The motivation for the research and hypotheses presented so far was the need for a new discussion system at the Human Computer Interaction (HCI) group at the Department of Design and Assessment of Technology, Faculty of Computer Science, Vienna University of Technology. This need arose as follows.

6.1 “Slidecasting 2.0” and the “radical portfolio”

Higher education in Austria is marked by two principles: Open access and low cost. The following applied for decades: Everyone who graduated from high school was entitled to enrol in any university program at any public Austrian university (except Art universities). The cost for this education was zero from the seventies to 2001, then it rose to about €360 per semester. In 2008, a new law effectively caused most of the students to be exempt from the tuition cost again. In 2005, admission tests were introduced for some of the most popular programs, because the number of students enrolling was too large for the system to sustain, not least because of incoming students from other EU-countries who, by law, must be afforded the same rights as Austrian students.

Between 2001 and 2008, the number of total students in Austria rose from 182,805 to 223,562, an increase of 22%. In 2009, Vienna University of Technology had 5,705 students in its various programs in computer science (22.7% of the university’s total students), 1,075 of them first-years (of either an undergraduate or a graduate program). It is not uncommon to have several hundred students in one lecture of a first-year computer science class. (Statistik Austria 2010; Vienna University of Technology 2010)

A teacher holding a class with this number of students cannot hope to engage in any type of meaningful group discussion; the acoustic and spatial limitations alone prevent this. From 2006 to 2009, Peter Purgathofer, associate professor at this group, gradually developed (and used) a “Slidecasting” system. He had been teaching an introductory class on the connections between information technology and society, and noticed that a large percentage of students used to bring their laptops and use them in class, to take notes or do things unrelated to the lecture.

Purgathofer and his collaborators at the HCI group decided to attempt to turn the high number of students and their high connectivity into an asset. They introduced a web application via which slides were published to all class participants at the time they were presented in the lecture. Students could take notes and share them with others. They could post questions and additional information and interact with the teacher. This form of collaborative, synchronous or asynchronous knowledge construction was used to enhance, not replace the traditional lecture format; it was inspired by Downes' vision of "E-learning 2.0". (Purgathofer & Reinthaler 2008)

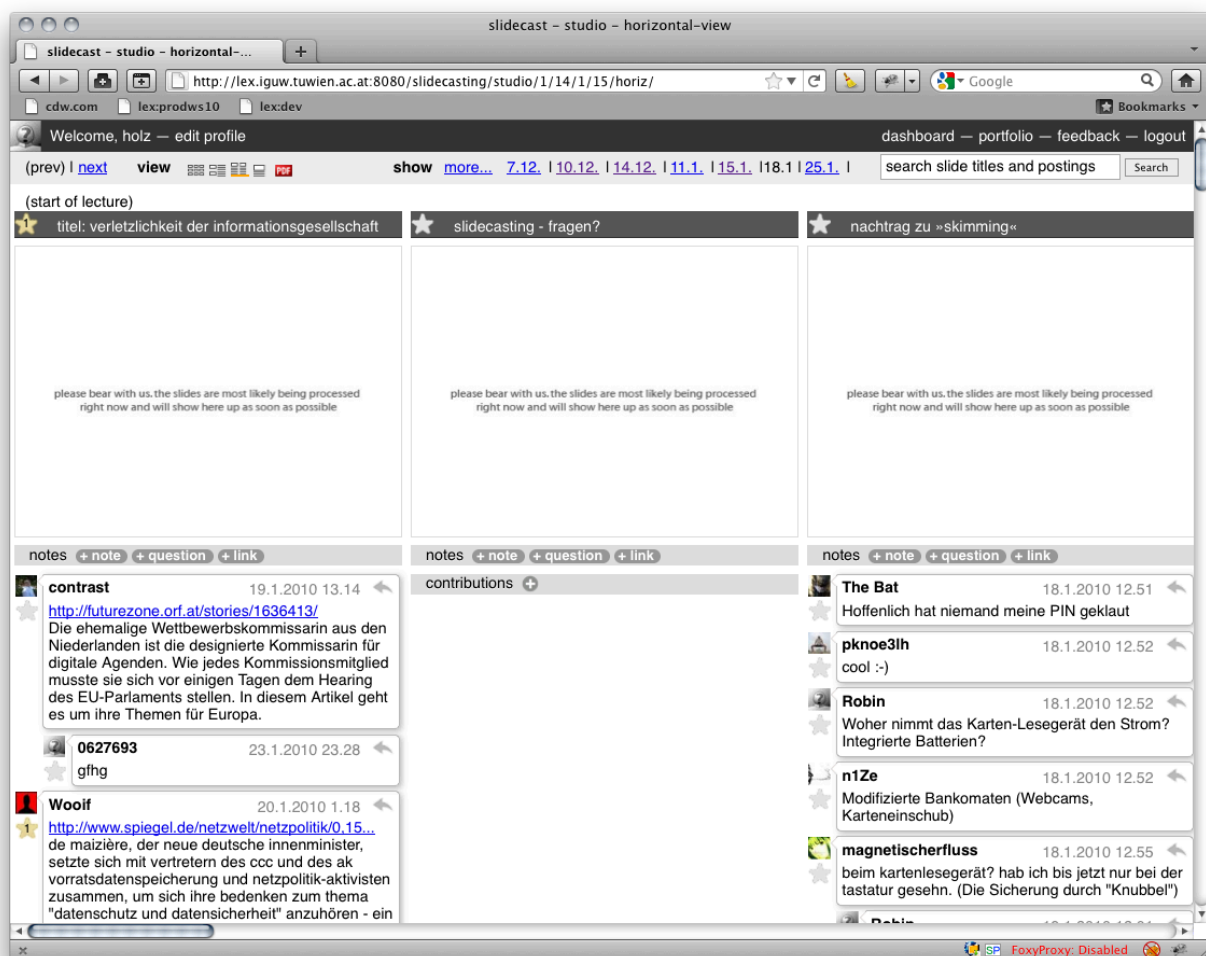


Fig. 26: Slidecasting in fall 2009 (slide pictures are missing). Each column displays a slide + notes/comments.

Around the latest "Slidecasting 2.0" system, a more comprehensive "radical portfolio" framework was built that allowed contributions to be made in various forms. The ultimate aim was to do away with the traditional forms of deadlines, assignments and exams and foster a way

of continuous discourse and contributions around the class subjects that would then be assessed in their whole weight. (Purgathofer 2009)

For classes in fall 2009, a comprehensive system was in place, with *slidecasting* at its heart.(see Fig. 26) The system also featured forms of integrated AOD: Every slide had a set of public notes and the admins (teacher, teaching assistants, student assistants) could post discussion prompts that would then lead to a separate discussion page (i.e. a thread detail page). This discussion had limited functionality and and I offered to develop a new discussion system as a thesis project.

In the following sections, I describe the requirements, design process, development and evaluation of this system. Most larger design decisions were made jointly with Prof. Purgathofer.

6.2 Requirements

6.2.1 Status quo

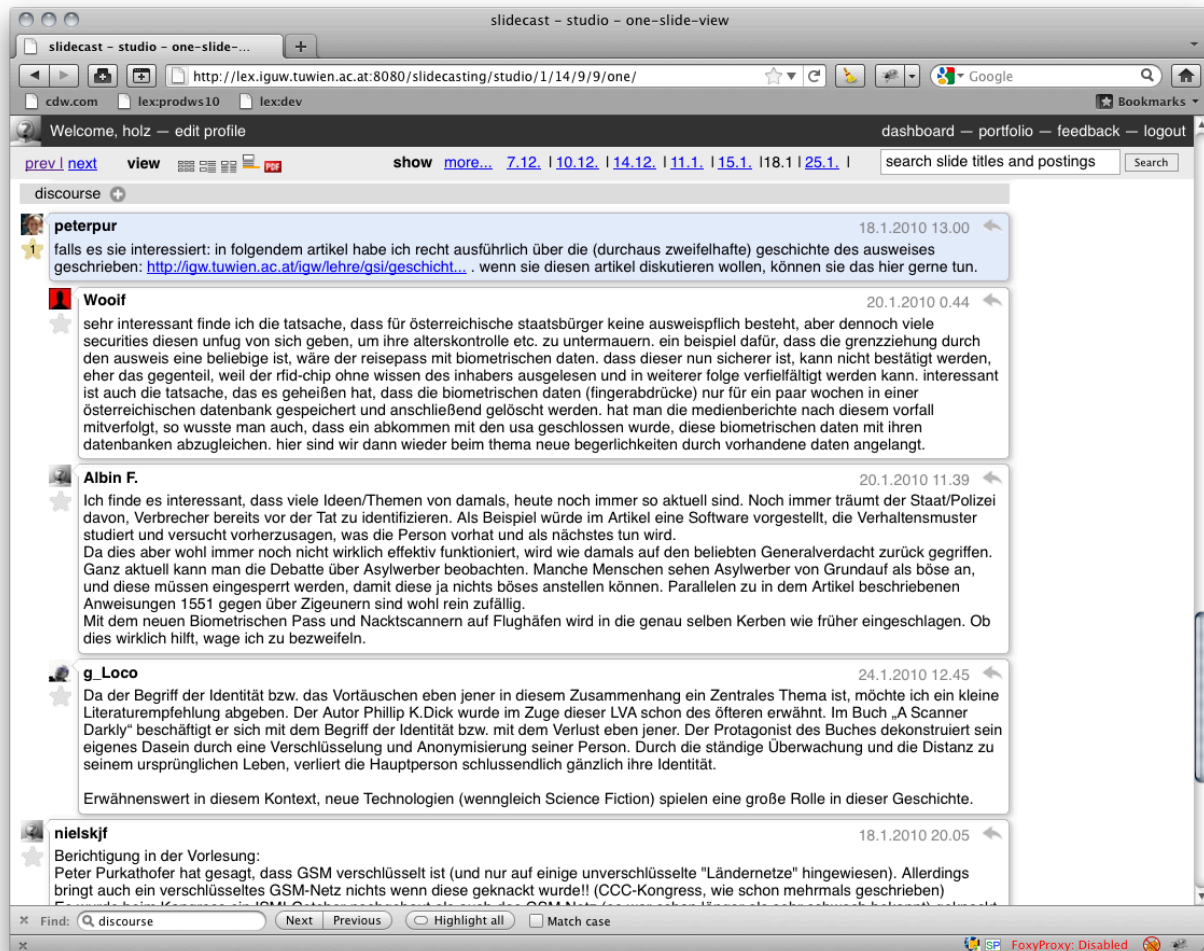


Fig. 27: The “discourse” section of a slidecasting item in the old system.

The discussion system already in place involved threads attached to particular slides. The reply tree allowed up to two layers (i.e. the first-level reply and a reply to a reply), with a slight indentation of the second layer. Posts were represented with an avatar picture and a speech bubble containing the actual content and buttons to reply and to edit one’s comment. Even with a moderate amount of replies the linear structure favoured the first few posts and made it hard to distinguish between a broad and shallow, and a deep and narrow tree.

In an interview with Prof. Purgathofer, he described the following problems with the old system:

We saw that this very primitive concept of having a post and a reply, and only one layer of indentation, is too thin for having real discussions and that the result of the large number of posts that came, because everybody wanted to participate, was that the first 20, 30 people actually read what was there and reacted, but all others were overwhelmed and just posted what they were thinking - and that can't be the point of the whole thing.

(P. Purgathofer, personal interview, 22 June 2011; my translation, P.H.)

But why not use a more sophisticated established forum system?

One could have just used a discussion forum instead of this simple posting-and-reply functionality, but my experiences in online discussion systems, in forums, are not so that I'd say, "Yes! Let's take a forum, because forums work so well." Forums don't work well at all. As a representation of a real discussion they are inadequate. The example that I always use [...] is: Depending on the representation one can either choose to have a chain of replies represented well, in which case all other [direct] replies to a posting are not visible because they are pushed away by this chain, or all replies on one level [...] are well represented, but then it is impossible to follow the further thread of the conversation. And that is the result of this form of representation, this indentation, that really treats a discussion as something linear even though it isn't. So the idea was to search for other forms of representation. [...] How can one enable online discussion so that it doesn't just pretend to be a real life discussion, just inadequately presented, but that particular forms can develop?

(ibid.)

Purgathofer called this last problem, the mere translation of traditional forms into the digital, "hermeneutic extrapolation". In traditional forum systems, he saw too much of this extrapolation, and he wanted to take the chance to try an approach that does less of it. On a more pragmatic note, another problem that most forums exhibit, so Purgathofer, is that it is extremely difficult to stay on top of a very active discussion, i.e. to see where things are moving forward in an interesting direction. (ibid.)

It becomes apparent that there were a number of problems with the old, minimalistic solution, that motivated the development of a new system instead of the inclusion of an established one.

The differences between the old and the new system are highlighted more in the following sections, where I refer to the old discussion system as *discourse*, since this is the title the discussion sections had.

6.2.2 Social context

The courses taught by the HCI group revolve around design and social issues in information technology. Hence, discussion was expected to be divergent, like *Slashdot* discussions on privacy, rather than of a question-and-answer format in the manner of *StackOverflow*. The optimal size and design of discussion groups was an open problem, but the incorporation of such groups could be expected. The expected setting was thus a medium-sized group debating questions that do not usually have one “solution” but need to be explored through constructive discourse. Supervisors would participate in the discussions on a regular basis, although not all discussions among all groups would be permanently monitored.

It could be assumed that there would be periods when many students are online at the same time, hence the system should allow for some indication of the presence of others, and should support a near-synchronous discussion as well as a strongly asynchronous one.

6.2.3 System context

The existing larger framework had several components: *Portfolio*, which allows a collection of contributions and an assessment by the teachers, *Slidecasting*, the collaborative note-taking, and *Dashboard*, a view weaving all activities together. In the *Slidecasting* module it was already possible to award “stars” to public notes or contributions, i.e. to indicate that one finds that contribution valuable. This functionality needed to be extended to the new discussion module, as well as the capability to edit one’s own posts.

In addition, the aesthetic integrity of the system should be honoured by translating the look and feel to the discussion module.

6.2.4 Technical context

Technically, the whole system operates on a web server run by the department, with the Python-based web application framework *django*, the database system *MySQL* and the JavaScript framework *jQuery* as main technologies.

One of *django*'s core features is an object-relational mapping, i.e. classes derived from a "Model"-class are automatically translated into corresponding database tables with an included tool. Modifications and queries are performed on those objects; *django* automatically takes care of performing the corresponding SQL commands and translating the results back into *django* objects. HTTP requests are handled by *django* "views", functions in which the necessary queries are performed; the results are typically delivered via rendering a *django*-"template". These templates are HTML/CSS/JavaScript amended by *django* template language code which is used to determine how the data delivered from the server is to be integrated with the HTML-based layout.

jQuery is a JavaScript framework that greatly simplifies DOM (Document Object Model) manipulation, the technique used to alter page content without reloading. It also provides functionality to send HTTP requests and define callback functions, and thereby to modify the page based on AJAX.

The new discussion module needed to be integrated into the framework as a separate module, or "application", in *django* terminology. It should not place too large a load on the server, and should operate well under a load of 50-150 simultaneous connections, and reasonably well under an assumed maximum load of 500 simultaneous connections. It needed to comply with W3C standards and run in Mozilla- and Webkit-based browsers on any operating system (most notably Mozilla Firefox, Opera, Google Chrome and Apple Safari, and their mobile pendants). These browser families together have a combined market share of about 45% (W3C 2010), compared to Internet Explorer with 44%. The target user base for our first installment of the module (students of computer science) could be expected to use Internet Explorer significantly less.

Current W3C statistics (ibid.) show that at least half of all visitors to their tracked sites have a resolution of 1280 x 800 or higher. We regarded 1280 x 800 as the minimum resolution on which our AOD module should be comfortably usable.

6.2.5 Structural improvements

The education context meant that learning from discussion was the primary goal, and as such the requirements described in 3.4.2 apply. With respect to the status quo, especially mechanisms for the following needed to be introduced:

- *Time and complexity management through improved filtering.* Attention-directing mechanisms and information for filtering should help discern the new and/or interesting sub-discussions from the others.
- *Structuring the discussion.* So far, off-topic sub-discussions were getting as much attention as anything else. The way sub-discussions are grouped after distinct ideas should feel as natural as possible; if that is the case, off-topic branches of the reply tree can be ignored because they are easily distinguishable as such.
- *Multiple references.* It should be possible to allow for a direct grounding of contributions in other posts without verbatim quotes.

On top of that, the visual structure should harness the screen space that is typically available on standard-resolution displays.

6.3 Design Ideas

6.3.1 General structure

The most fundamental decision was how the reply tree should be represented, both internally (in terms of Django models) and visually.

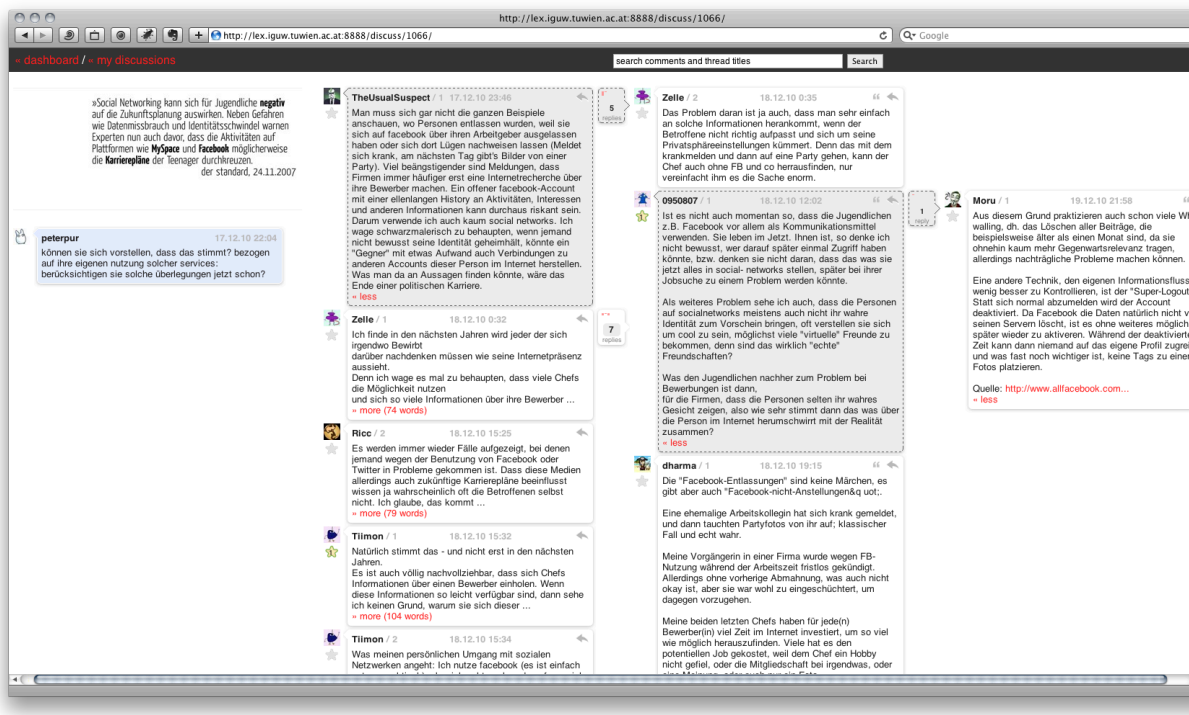


Fig. 28: Structure of *discuss*. Columns, from left to right: Discussion prompt, top level posts, active second-level responses, active third-level responses. The path through the active discussion is highlighted in grey.

Arguably, a linear view makes most sense when the reply tree is either broad and consistently shallow, like on *Flickr* with its one-off comments, or extremely narrow and deep, as in an instant-messaging discussion between two or three people. In the first case almost every response relates to the initiating post, making references and depth indication rather unnecessary. In the second case, every post can be assumed to reference what has been said immediately before it, similar to a face-to-face discussion; and if it does not, it is unusual and has to qualify this deviation anyway. The discussions for which the module is to be designed, however, must be expected to be broad and deep, and very long, at least occasionally.

We decided that the system should not impose a limit on reply depth internally, so that even deep sub-discussions are not flattened. It should be reasonable, then, to use an *expanding menu* as *Moodle* does, perhaps with visibility filters based on ratings, similar to *Slashdot*, to keep an overview of it all attainable even in long discussions. There were two arguments against this structure: First, this type of system would have to list all posts below each other, with indentations according to depth. This would yield a lot of horizontal whitespace unless we extended the width of each post far to the right. Such an extension, however, would break the

aesthetic consistency with the narrower columns of the slidecasting module. Furthermore, readability would probably suffer, as studies have shown that best on-screen readability is achieved with 50-60 characters per line, the line length of the slidecasting columns. (Dyson 2001)

Second, there is always a strong trade-off between overview and detail. Collapse all subtrees and you get reasonable overview. Open any subtree and it takes the space that the top-level posts used to take by moving them down, typically out of the visible area. We wanted to see if it was possible to mitigate that trade-off.

So, what structure should we use? For broad, deep trees, another view has proven useful: *Miller Columns*, named after their inventor Mark S. Miller from Yale University, were used in *Project Xanadu*, *Datapoint* and *NeXTSTEP*, and subsequently (and most notably) in the Mac OS X Finder. (Wikipedia, “Miller Columns”) They display each layer of a tree in one column: The first-level nodes are displayed below each other in the leftmost column; when the user clicks on a node, its subnodes are displayed in the column to the right, and so on. In a file browser, this is a great compromise between detail and overview: Where the overview is lost as one opens more subfolders in the *expanding menus* view as indentation is not quite enough of a visual separation to avoid any confusion between nodes of different levels, such a confusion cannot arise with *Miller columns*, due to the much stronger visual separation. All nodes on the current path are always highlighted, indicating clearly the position in the tree. There are, however, three disadvantages: First, deep trees involve a lot of horizontal scrolling, with higher nodes disappearing to the left. Second, the horizontal space is limited, since increased horizontal space would make higher nodes disappear even faster. Third, only one subtree can be visible at any time, since two sets of children on the same layer cannot take the same column simultaneously (and if they did, it would probably be very confusing).

The second disadvantage was rather an advantage in our case, as it has just been remarked that we needed a way to harness the horizontal space. The first and the third were problems that would possibly prove too big to be tolerated, but we were willing to take that risk in order to try a new visual structure for our module.

The general layout, hence, was to be the following: In a thread (discussion prompt by the teacher) it should be possible to post a top-level contribution, i.e. an idea, question, fact or opinion that directly relates to the prompt. This first level would constitute the first and leftmost column, close to a display of the prompt itself. Every post in this column would then provide a

reply-button and a “show replies”-button. The latter would display all the direct replies to the selected post, the former would do the same but also activate a form for posting a new reply. This form would be attached at the bottom of the column of children, exactly where the reply would be inserted. Upon submission it would appear at that very place instantly, while it would be added to the database via an AJAX POST-request. Every thread would correspond to one HTML-page which is manipulated and updated via AJAX as replies are posted and edited, without the need to reload.

6.3.2 Attention and filtering

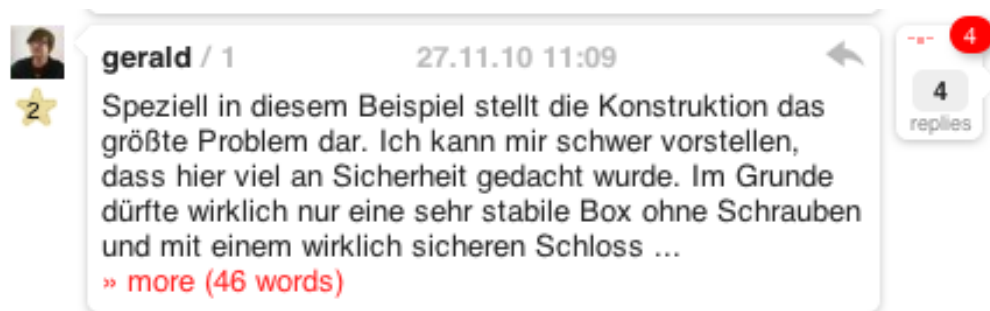


Fig. 29: A post in *discuss*.

Left: User avatar and “star” ratings. Middle: User name, post ID, time, reply-button; post text and “more” button to show the full post. Right: “Unfold replies” button with total number of replies, (black on grey background), number of unread replies (red badge) and sparkline displaying reply distribution.

The Miller Columns layout meant that the user would not be able to see more than one set of children of a particular depth at once. Therefore, it would be particularly important to provide functionality that facilitates filtering. It would have to be easy to identify the theme of a subtree, the size and the general structure of the discussion, and attention would have to be directed to trees containing recent and/or unread contributions.

The simplest and most essential data about a post are the content, the author, the date and a unique identifier. Author, date and identifier would be contained in the post header, a line above the content. The next most important information in our view was the total reply count, direct and indirect. This would, in purely quantitative terms, indicate how much interest a post can evoke. This alone, however, would not allow to distinguish between a narrow, deep discussion between two participants and a shallower, broader response by many different users. One option was to introduce other measures: Number of total replies, number of direct replies, number of different authors replying etc. More numbers, especially ones giving such specific and unusual

information, would require more labels, and we wanted to keep the meta-information minimal in terms of text, to give the content more space. Edward Tufte found words to describe the goal that we wanted to reach: “Graphical excellence is that which gives to the viewer the greatest number of ideas in the shortest time with the least ink in the smallest space.” (Tufte 2001)



Fig. 30: A simple sparkline graphic.

A solution was found in *sparklines*, “data-intense, line-simple, word-sized graphics.” (Tufte 2004, p. 51) A typical sparkline is shown in Fig. 30. Sparklines have the highest possible reasonable “data-ink” ratio (Tufte 2001) and they fit into a regular line of text. Exact readings are difficult, but the data density is much higher than any array of numbers could accomplish, and the *relative* measure of data in comparison to a particular value, repeated in many sparklines and thus allowing for parallel visual processing, is often more useful than a more exact depiction that would require much more space. The type of sparkline we were looking for, however, was different than the one in Fig. 30. We wanted to depict the distribution of replies among the various layers. For this type of discrete scale with comparatively low density in x-values (the depth), the sparkline version of a bar-chart would be most appropriate.



Fig. 31: Unfold-button with sparkline at the top.
The three bars indicate a high branching factor on the second reply level.

Fortunately, there is a sparklines plug-in for jQuery which we were able to use. The bars of the sparkline would use an inverted Y-axis to function as iconic representations of the shape of the unfolded reply-tree (see Fig. 31). We decided to use the average reply count across all sets of children of a certain depth as the data for the chart. Why the average rather than the total? Given a perfect binary tree with a depth of six, every post would have exactly two replies, i.e. the second layer would have a total of two, the third a total of four, the fourth a total of eight and so on. The

sparkline graph would therefore depict the function 2^x , i.e. a slope with exponential growth. Unfolding the tree to view the replies, however, the user would see only two posts on each layer, because the branching factor is constant. Clearly, the iconic representation of this would have to be a constant bar size; thus, we used a function of the average branching factor over the depth. In a very “lopsided” tree, this would mean that a constant average branching factor might still not correspond visually to a particular path through the tree, but for the small size, some information has to be compromised. It is easily possible to distinguish a shallow, broad tree from a narrow, deep one, i.e. a long one-to-one conversation from a short large-group conversation. This would not be possible with a graph of total children, but is important to quickly identify, for example, a back-and-forth dialogue between only two, or a topic that entails a deep discussion among multiple people.

The sparkline is shown along with the number of total children in a rectangular bubble-button next to each post (if the post has any children at all). Clicking this button results in an unfolding of the next layer of children. There are a few other very important pieces of information about a subtree in this button.

One is how many unread posts it contains. Nearly all online forums in the tradition of bulletin boards show whether a thread contains unread posts or not, to delegate a filtering task otherwise handled through cumbersome semantic analysis (“this thread appears to have more posts than a few days ago, let’s open it and see if I’ve already seen them all”) to simple visual processing (bolder/redder/brighter for “contains unread posts”, regular for “no unread posts”). Since *discuss* has hidden parts within a thread (rather than listing everything in a linear or expanded threaded view), showing the read-status of branches is necessary to avoid redundant reading. The read-status is shown as a “badge” in the corner of the unfold-button, similar in style and inspired by the unread-badge on the dock-icon of Apple Mail in Mac OS X. By clicking on the badge, the user is taken to the first (top- and leftmost) unread node in the tree, with layers progressively unfolding if necessary.

Another piece of information in the unfold-button is how many posts have been made recently. “Recently” in AOD could be one hour or 24 hours or a week. We assume that 24 hours are a good measure of very “recent” posts. The problem we were facing when integrating the recent-posts measure was that we already had two numbers and a sparkline graph without labels that should speak for themselves. Another number would make labels necessary or introduce

difficulties in interpreting the numbers. The number of recent posts was thus encoded in a coloured box that serves as a background for the number of total children. The more recent posts have been made, the “redder” the box is. This gives no absolute number, but directs attention to the branches with more recent activity. This is especially important since the posts in a column are always ordered top-down chronologically, i.e. in long columns older posts show up first. Since this is a detriment to filtering to the benefit of orientation, filtering is supported by the colour coding. Spence (2006, p. 55) notes that encoding a value in colour or density of a filled shape is inaccurate compared to position, length, area or volume, but accuracy is, in this case, not very important, while the additional attention-heightening quality of a red hue is beneficial in this case.

6.3.3 Live updates, synchronicity and social presence

It is a common phenomenon in *informatik-forum.at* (IF) that someone asks a question and within ten minutes or so two or three people post the same answer. The ones that weren’t first might then go back, edit their post and amend it with a note “edit: <username> was faster”, <username> being the nickname of the person who posted the first answer. Why does this happen? IF has many users, a few of them are online for hours at a time every day and seemingly check the forum very often. When one of these regulars, let’s call her “Alice”, sees a new question and feels capable of answering it, she will. While Alice reads the question or types her answer, someone else, perhaps “Bob”, will see the question and start typing an answer, too. While Bob is still typing, Alice submits her answer. Bob doesn’t see Alice’s post until he refreshes the thread detail view, which means not before he has finished and submitted his own answer. If the answers are very similar Bob might go back and insert a note like the one mentioned earlier.

We could consider this typical to asynchronous communication. However, as mentioned, asynchronicity and synchronicity are just extremes of a range of the possible temporal relation of messages. If, in order to avoid the problem just described, we were to change the system so that new posts to a thread appear while we’re still in the detail/quick-reply view or the advanced-reply view, we would suddenly find the system halfway between a bulletin board and a chat or instant messaging system: New messages appear as they are submitted, without the need to refresh the

page, but the length of messages and general organisation is still closer to a traditional online forum.

This functionality is, of course, possible with AJAX, and it is the way *discuss* behaves. The client's JavaScript code in the browser polls the server' django view in regular intervals (ten seconds proved to be a reasonable compromise between responsiveness and server load) to compare the thread-tree structure in the database with the local structure and insert or update posts if needed, even as the user is typing their own post into the reply form. Similarly, one's own posts are dynamically added to the page, sent to the server to insert into the database and, ten seconds later, dynamically added to the pages open in other users' clients. If someone creates the first child to a post, the mechanism to show the subtree, including sparkline and other data, is added as well. If a post is added to a subtree that is currently hidden, all the data (number of children, sparkline etc.) about this subtree is updated. These mechanisms help to avoid the interruption that comes with reloading the page and, if there are several other users working on the same page, increase social presence by making actions take effect immediately (or with a delay of only a few seconds) and automatically. The concept of an e-mail client that does not receive and show new messages automatically and in very regular intervals seems antiquated – the same applies to the concept of static pages that one has to reload to check for news.

6.3.4 Multiple references



Fig. 32: Quoting the first post in this thread by user TheUsualSuspect in a response to a post by user mataut. The reference is inserted when the user clicks on the quotation marks above the post to quote.

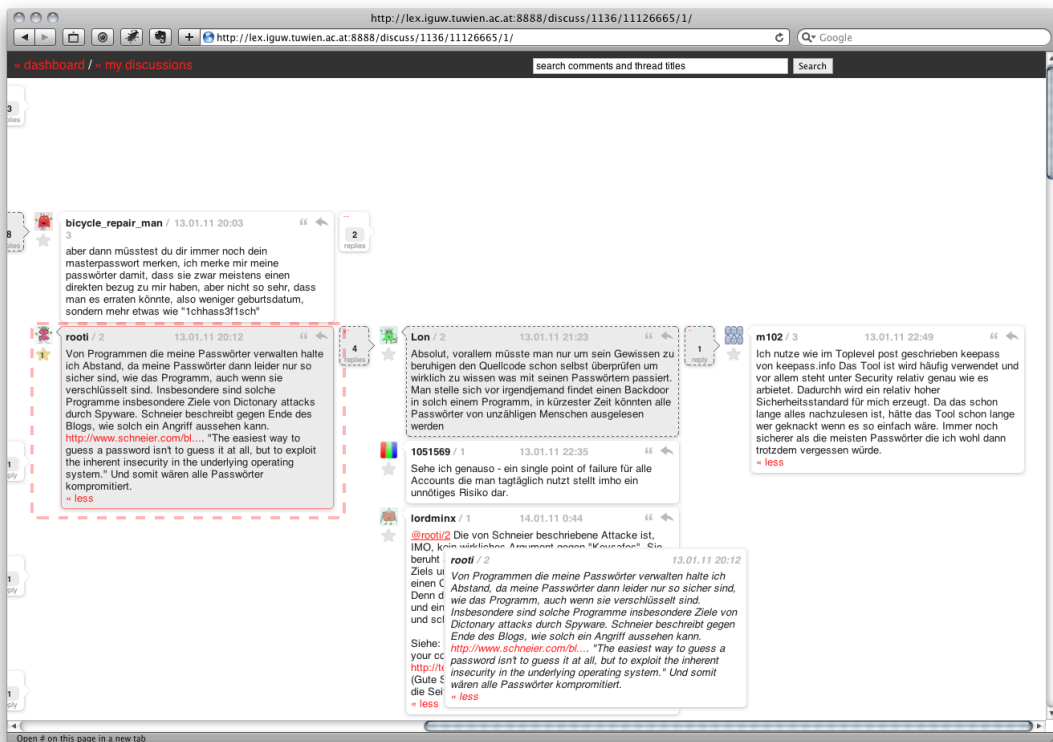
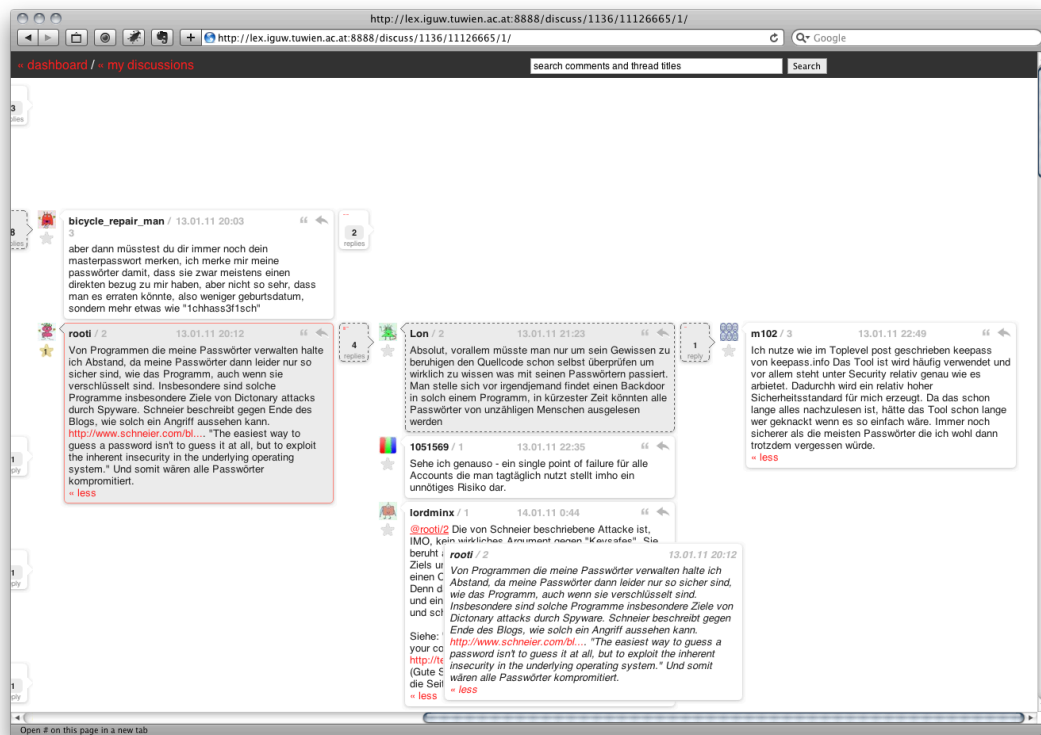


Fig. 33: User *lordminx* references post *rooti/2*. On mouse hover, the post is highlighted and floated next to the reference (top image). On click, a dashed border flashes around the original (bottom image).

Multiplexing should not be necessary in *discuss* since it is easy, even necessary, to post a reply to a particular post directly below it in the hierarchy. Multiple references for purposes of synthesis, however, are sometimes desired: Let us consider a situation in which Bob replies to Alice and Charles replies to Bob. If Bob critiques Alice's statement and Charles agrees with Alice, Charles could expand on or clarify Alice's argument and would maybe want to indicate that. In addition, Charles might want to draw on Dorothy's post which is in a different branch, but introduces a fact that is useful for the current reply. To enable Charles to reference Alice and Dorothy, *discuss* has a "reference" functionality. A "reference" button appears in the buttons toolbar of every post as soon as a reply form is active. If Charles clicks the reference button in Alice's post, "@Alice/<n>" is inserted into his reply, with <n> being a number indicating Alice's *n*-th post in this thread. When Charles' reply is submitted and displayed, the "@Alice/<n>" is parsed into a link. If the user hovers the cursor over the link, the referenced post is displayed in a pop-over next to the cursor, and also highlighted if it is already visible on the page. If the user clicks on the link, the referenced post is either highlighted more strongly by a temporary, flashing red border or, if it is in a different branch, the user is taken to it: The tree collapses and gradually unfolds to the referenced post. But how does the user insert the reference in the first place if the referenced post is in a different branch, as it (and its reference button) is not visible while entering the reply? In that case, the user has to type "@<username>/<n>" manually and it will be parsed correctly. So far, this has proven to be most economical regarding performance and overview. It is not hard to remember the *n*-number of the post and the reference syntax follows the "@"-pattern common in online forums. On top of that, it is unlikely that cross-branch referencing is so common in any setting that it would warrant an extension of the direct manipulation principle to this case.

6.3.5 Other features

The screenshot displays three search results for the term "windows". Each result includes a user profile picture, a star icon, the username, the number of replies, the date and time, and the post content with the search term highlighted in yellow. To the right of each post is a link to "view post in thread".

Post 1: Inlifferty / 1, 6.12.10 23:18. Content: Also ich denke schon das eine 100% Entfernung möglich ist. Wenn man jetzt von LowLevel Viren absieht (BIOS, SMM, Grafikkarten/Netzwerkarten-ROM) - die ja auch noch nach dem Neuaufsetzen existieren - kann alles entdeckt werden. Im schlimmsten Fall kann man es mit einer LiveCd und viel Zeit beweisen. Bei heutigen Viren/Trojanern/Rootkits ist das meistens nichtmal nötig. Da ich mich selber Rootkit Author schimpfen kann (einerseits um Malware zu analysieren, andererseits um Anti-Cheat Systeme in Spielen zu umgehen), weis ich was Möglich ist. Bei der Analyse von Anti-Cheat und Anti-Viren Software bemerkt man, dass diese sehr ähnlich arbeiten. Aber um beim Thema zu bleiben - allein der Thread Scheduler bei **Windows** ist ein Problem, dass man Prozesse nicht einfach so verstecken kann ohne das man sie wieder findet (schließlich muss die CPU auch wissen, dass sie den Code ausführen soll). Der Rest funktioniert über Abgleich der File-Hashes mit einem uncompromittierten System.

Post 2: Moru / 1, 6.12.10 20:10. Content: der von dir genannte Kommandozeilenbefehl bricht das Herunterfahren ab (-abort) Im Endeffekt ist das ein normaler **Windows**befehl, der auch recht nett ist um erst nach einer bestimmten Zeit herunterzufahren. Oder wenn man Informatiksaal der HTL Bulme ist und die IP der Schüler bzw. auch Lehrerrechners kennt XD

Post 3: 1026737 / 3, 6.12.10 18:27. Content: svchost hat nichts mit dem namen zu tun, das war nur der processname als tarnung unter den anderen 7+ svchost prozessen die unter **windows** normal laufen...

Summary: in vorfälle 1988-2003
10 replies
» view post in thread

Summary: in vorfälle 1988-2003
1 reply
» view post in thread

Summary: in vorfälle 1988-2003
1 reply
» view post in thread

Fig. 34: Search results page for the term "windows".

Discuss also includes other features that users are familiar with from other web communication services. There is a search field at the top that allows to search comment titles and texts. The search results are displayed in a column, with the search term highlighted in the texts and a direct link to the post.

The screenshot shows a post by user 1026737 with 3 replies, dated 06.12.10 18:27. The post content is partially visible: "ts mit dem namen zu tun, das war nur der processname als tarnung unter den anderen 7+ svchost prozessen die unter windows normal laufen...". A pop-over menu is open over the post, showing "rss / permalink" options. To the right of the post, there is a "1 reply" button with a red notification bubble containing the number "1".

Fig. 35: RSS and permalink features are accessible from a pop-over menu.

The direct link is another crucial feature. One downside of an AJAX-based discussion system is that linking to a particular post is not as straightforward as with a static system in which every post has a corresponding HTML document. The solution for *discuss* is a direct link the parameters of which are processed via *Django/jQuery* so that when the page is loaded, the tree unfolds until the desired post is visible; the post is then also highlighted with a flashing red border, to attract the user's attention. The direct link is used for the search results, but it can also be obtained from a popover menu that appears when the user clicks on the post header (as a "permalink").

The popover menu also contains the link to an RSS service: For every post, the user can subscribe to an RSS feed which contains all (direct or indirect) replies to the post. This is an addition to the automatic notification service which sends an e-mail to a user if one of their posts has received a direct or indirect reply.

6.4 Development Process

6.4.1 First prototype

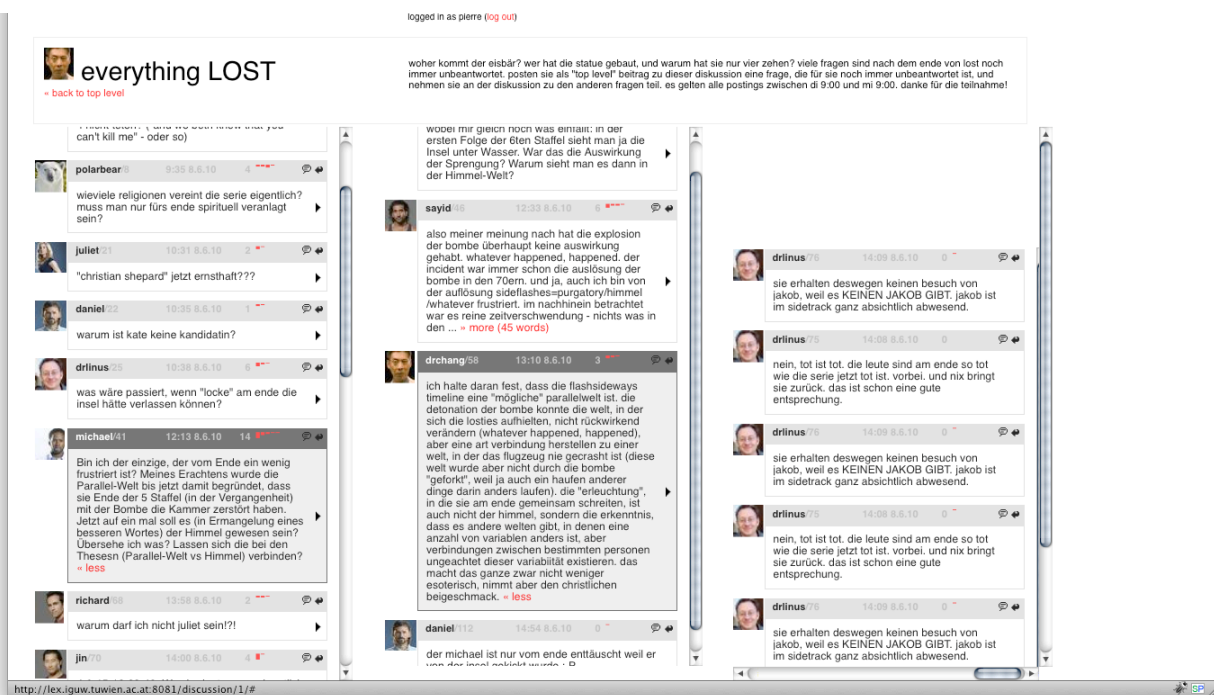


Fig. 36: Early prototype version. Screenshot from a test-discussion in June 2010.

In the first prototype, mostly implemented in May and June 2010, the column layout approach was the central concern. A column width of 260 pixels (in default browser zoom), a type size of 10 pixels (Arial) and minimal graphics made the layout very compact. The number of replies and the replies-sparkline was displayed in the header (making space in that line rather rare, with all the other information such as author, date and id). The very first version translated the *Miller Columns* scheme directly, but we found that by setting the top of a column to the top of its parent post, not much space would be wasted, yet it would be easier to recognise the active path.

We conducted a test with twenty users; most of the participants were students themselves, but affiliated with the department. For one day, we let the participants discuss the TV programme “LOST”, the last season of which had just finished. We asked for feedback once the discussion was closed, but we also provided the opportunity to discuss the system itself in a second thread. The feedback, in summary, concentrated on the following issues:

1. Font sizes were too small; in the default browser zoom the text was not easily readable
2. It was unclear what the sparklines indicated
3. Users asked for a feature highlighting unread posts or new posts
4. Users asked for a feature to “unfold” a subtree with one click
5. Users asked for a feature to see multiple branches at once
6. Several bugs were pointed out

(1) was easily remedied by simply choosing larger fonts and bringing the design generally closer to the clear, large, clean-cut design of the slidecasting module. (3) was subsequently implemented as described above. (4) and (5) were interesting suggestions, but they were opposed to the logic of Miller columns and tree structures: To unfold a branch with one click, only a constant branching factor of one is possible, otherwise it is impossible to decide which path to take. Likewise, having multiple branches unfolded simultaneously would cause them to overlap heavily. The bugs (6) included incorrect parsing of links, trouble with the form input field auto-expansion, lack of notifications for dead sessions etc. and were, for the most part, easily fixed. (2) was the most serious problem, because the sparklines conveyed information we regarded as important, but was not self-evident (and the use of sparklines is only reasonable if there is no need for labels etc.)

6.4.2 Second prototype

For the second prototype, developed in July 2010, all the graphical adaptations described were made, including the enlargement and visual adaptation of the message containers and the repositioning of all information in buttons shaped like speech-bubbles, to clarify that this gives evidence about activity in the respective child branch. The ratings system was integrated and performance was optimised (so that fewer HTTP requests would have to be sent for the periodic polling).

Again, we conducted a test with mostly the same users as in the first test, this time discussing higher education policy. Participation was significantly lower than in the first test. This may have had to do with external circumstances, the topic or the fact that on the first of the three test-days a defect in an unrelated module made it impossible to log into the system for several hours. Nonetheless, valuable feedback was attained:

1. Even after the repositioning, the sparklines were hard to comprehend.
2. One user suggested using keyboard navigation to avoid horizontal scrolling and to facilitate moving from one tree node to the next.
3. On the iPhone and iPad, there were several problems with the correct display of the layout.
4. On slower internet connections (on mobile devices), the loading of posts was felt to be too slow. Preloading was suggested.
5. More bugs.

The technical problems of this round were fixed and the load times optimised. The problems on mobile devices were noted, but were not a primary concern at that time. The sparklines were left as they had been, but the graphical indicators were improved to the status described in 6.3.2.

The keyboard navigation was discussed, but not adopted, since it would have required introducing a new selection mode that would have interfered with the present unfold-on-select pattern. The suggestion, however, was highly interesting, and it indicated the possible inconvenience of horizontal navigation: While screen space is more expansive in the horizontal direction, the primary axis of scrolling is the vertical one, and this is what most conventional mice

support with their scroll wheel; only recently have track pads and mouse balls started to make horizontal scrolling more convenient.

6.4.3 Production version for winter semester 2010/11

In October 2010, the next version went online, and was used for the courses “Gesellschaftliche Spannungsfelder der Informatik” (“Computer science & society”) and “User Interface Design”. It was used throughout the winter semester, up until the end of January 2011. In that period, it was necessary to address various bugs and compatibility issues, but no changes were made to the functionality or visual structure. This version is the one to which all screenshots and descriptions refer, unless otherwise indicated.

Students were directed to the discuss module via links in the slidecasting comments, and could choose a discussion group to participate in, so that one *discuss* page would not have to hold posts of hundreds of students. The production version also featured a “home screen” of all the user’s discussion groups (max. one per topic), and extended views for administrators.

Discuss was only partly integrated into the existing system: The link to a discussion would take the user out of the *dashboard* layout, to a new page. At the time at which the systems were connected, it was not clear how the *dashboard* layout would evolve, and *discuss* was easier to maintain as a module with its own layout.

6.4.4 Further integration

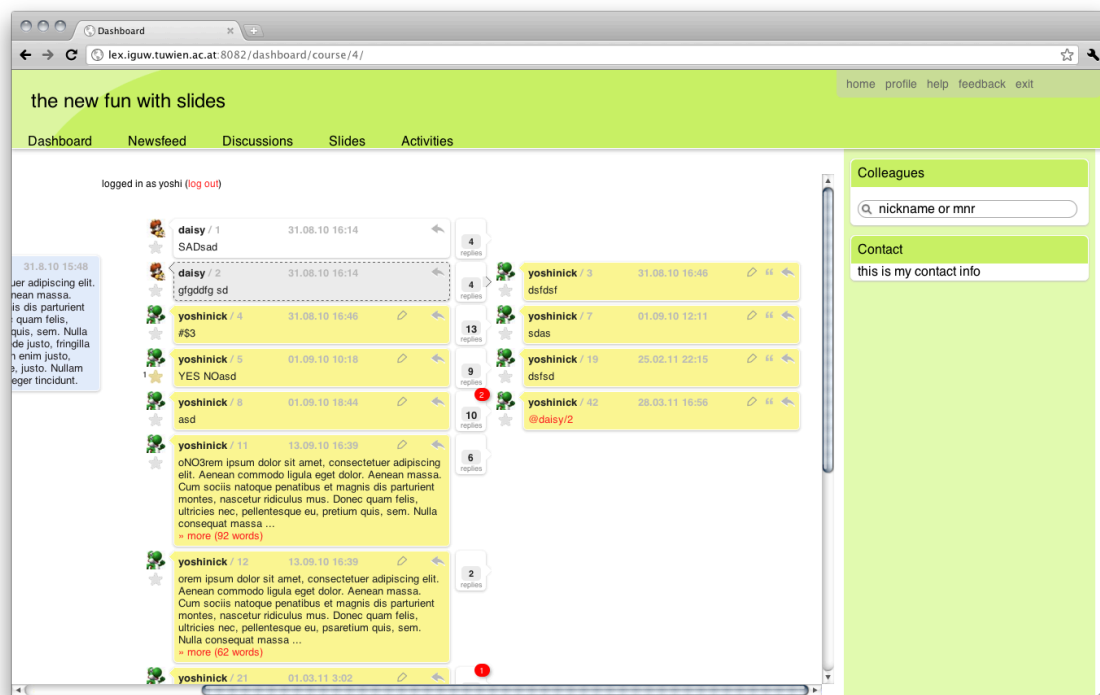


Fig. 37: First version of a better integration into the *dashboard* framework.

In February/March 2011, *discuss* was further integrated into the new *dashboard* system. Most importantly, the layout was adapted to fit into the existing framework. However, due to external circumstances, the lectures for which the use of *discuss* was planned did not take place in the anticipated form, so both *dashboard* and *discuss* were put on hold. For this reason, only the version used in the Winter semester 2010/11 is considered in the evaluation.

7 Evaluation

In the following the discussions of the class “Gesellschaftliche Spannungsfelder der Informatik” (“Computer science and society”), held in the winter semester 2010/11, are examined. The discussions were held between lectures (on a “preview” of the content of the upcoming lecture) and directly after a lecture, related to a specific slide or topic that was part of the lecture. The discussion prompts were sometimes questions about facts, but more frequently about opinions or personal habits and practices. It was not compulsory to participate in any discussion, but it was one way to earn points by posting content that the teachers regarded as very useful.

Where possible, the discussions are compared to those generated by the same (or a very similar) discussion prompt in the same class, held in the winter semester 2009/10. At that time, the discussion system, called *discourse*, was limited to an additional section attached to individual/collective notes in the slidecasting system. The depth was limited to top-level and second level, all replies that would have resulted in a level deeper than 2 were automatically attached at level 2. In the following comparisons, I only distinguish between “top-level” and “sub-level” posts, to accommodate for this difference.

7.1 Discuss vs. *Discourse*: Structure

The screenshot displays a discussion thread titled "Trust no one" in the "discuss" system. The thread consists of several posts and replies, organized into levels. The first post is by "peterpur" at 26.11.10 22:50, discussing the security of IT systems. It is followed by several replies, including one by "Morf" at 27.11.10 0:09, "Aizk" at 27.11.10 11:40, "BIS4711" at 27.11.10 12:20, "Aizk" at 27.11.10 14:00, and "BIS4711" at 27.11.10 18:07. The thread continues with more posts and replies, including one by "BIS4711" at 27.11.10 18:07. The discussion is structured with levels, indicated by the number of replies shown next to each post. The thread is titled "Trust no one" and is part of a larger discussion on IT security and trust.

Fig. 38: “Trust no one” discussion in *discuss*.

Fig. 39: "Trust no one" discussion in *discourse*.

Considering these factors, all of which are hard to measure, it is more revealing to look at the structure of the generated texts rather than purely on their quantity.

One of the most interesting questions is whether the more hierarchical, less immediately visible structure made a significant impact on the posting behaviour. In a discussion about the “trust no one” security philosophy, *discourse* had a total of 16 responses, but only three of them were on the second level (i.e. not responses to the original prompt). In *discuss*, the same question

triggered only nine responses, but five of them were on the second level or deeper. In fact, one response in this discussion was five levels deep: Two posters repeatedly responded to each other, creating a tangential but interesting sub-discussion. (See Fig. 38 and Fig. 39)

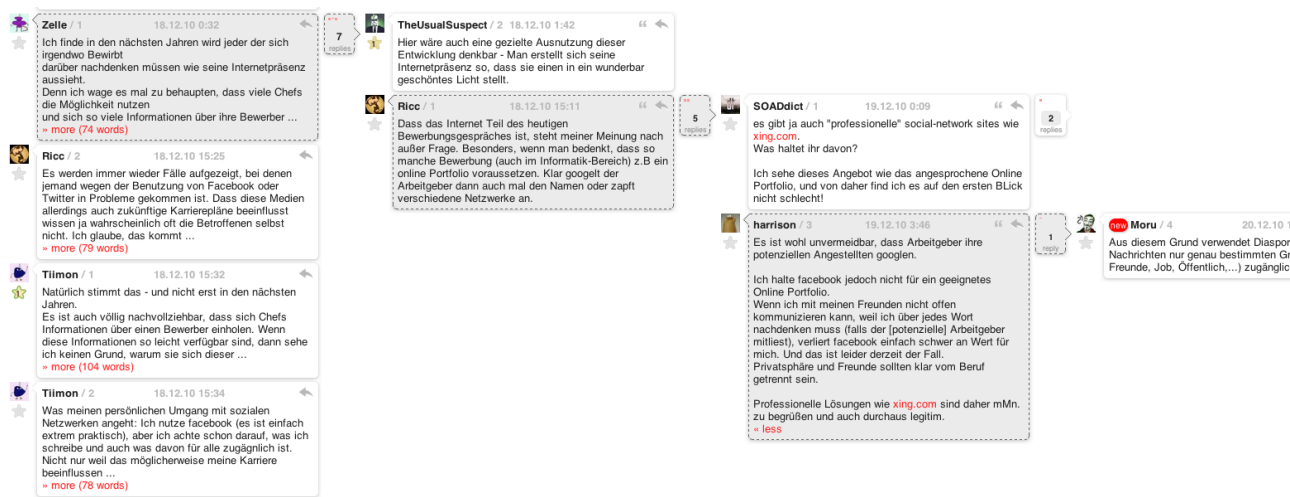


Fig. 40: "Zitat der standard" discussion in *discuss*.

A more extreme example is a discussion prompt quoting a newspaper that reports possible dangers of online social networks ("zitat der standard"): 67 posts (7 sub-level) in *discourse* vs. 37 (22 sub-level) in *discuss*. Here, the topic is more personal and emotional, and the result is even more of a dialogue. In *discourse*, the result is a wealth of @<Name> responses that are, semantically, hierarchically structured, but visually (and in terms of database logic) on the same level. In *discuss*, the same structure resulted in sizeable sub-discussions, leaving a manageable number (17) in the top level. Combined with the default-abbreviation of posts, the content displayed on page load can be scanned more quickly than the long column of 67 posts in *discourse*. (See Fig. 40)

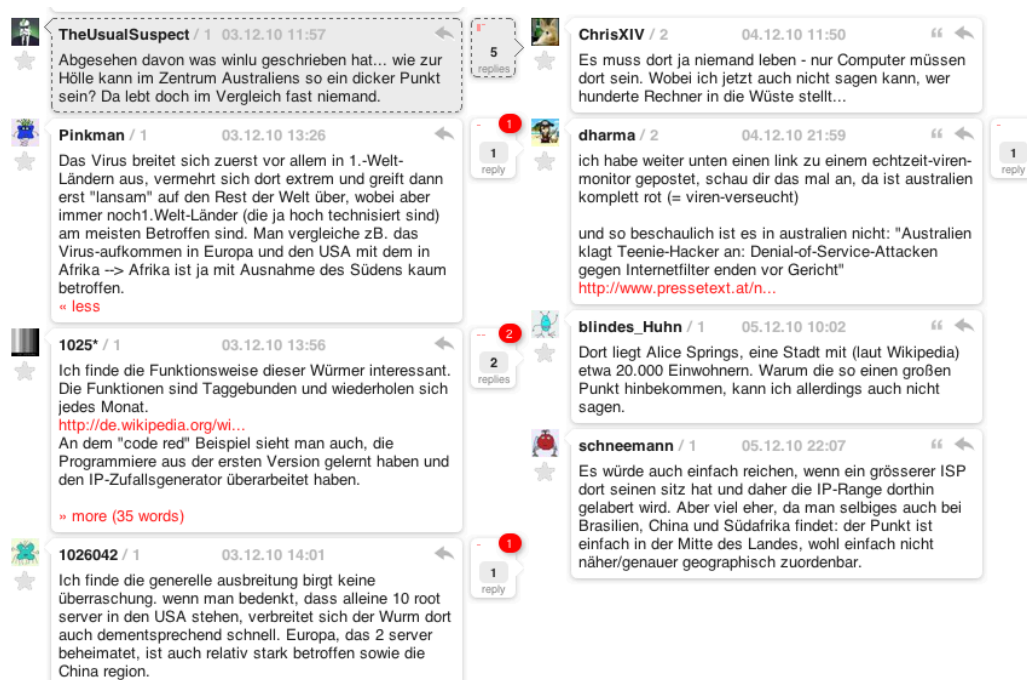


Fig. 41: "Code red" discussion in *discuss*.

Another example: A discussion about a map showing the spread of the "code red" virus. One of the discussion groups in *discuss* contains 28 posts, 14 of them at sub-level depth. Here, the speculation about the meaning of certain patterns on the map caused specific responses and sub-discussions in *discuss*. There is no equivalent discussion in *discourse*. It is a good outcome, however, that a discussion about an apparent outbreak of the virus in central Australia took place on lower levels. In *discourse*, the same discussion would have filled up the main column, tiring the reader. (See Fig. 41)

In other discussions, such as one about "Google wave" there is only a difference in the number of posts (most likely due to the relevance of the topic at that time), with no significant sub-discussions in either *discuss* or *discourse* (11 posts in *discuss*, 23 in *discourse*, 3 vs. 4 sub-level responses).

Generally, the significant structural difference resulted in the desired behaviour: The natural flow of the discussion resulted in semantic trees, removing clutter from the visual top level. The sometimes significant structural depth of conversations suggests that neither the small navigation overhead nor the reduced prominence of a non-top-level contribution prevented people from responding to a deeper-level post.

The average length of posts does not differ significantly between *discuss* and *discourse*. In “Computer Science & Society”, the average character count of a post was 693 for *discourse* and 605 for *discuss*, but in “User Interface Design” the average was 515 for *discourse* and 510 for *discuss*. Since in one course the difference is insignificant, it is likely that the difference for the other course should not be attributed to the characteristics of the system.

7.2 Use of other features

7.2.1 Referencing

Few people made use of the referencing (or quoting) feature in *discuss*.

Sometimes the reference was redundant: The author of the reply referenced the original post via reference functionality.

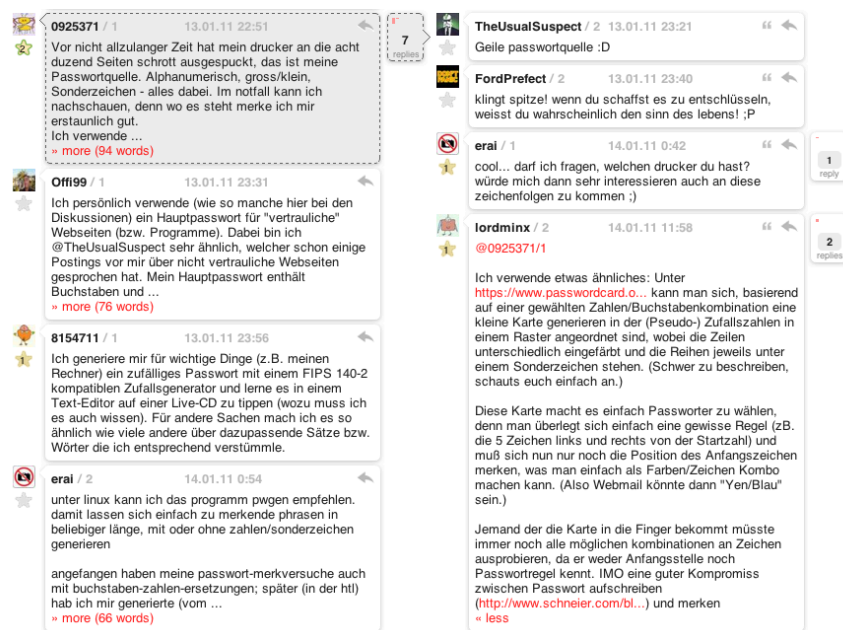


Fig. 42: Redundant referencing.

In such cases the author was most likely interested in making extra sure that it is clear they were replying to the original poster, and not to the previous replies to the original poster. If this had happened more frequently, it might have indicated a problem in communicating the structure of *discuss*. Even worse, in some cases users replied on the top level, addressing parts of their

answers to other top level authors. In one case, however, the author of the reply addressed two different top level posters in another top level post – he or she might have been unsure which of the two references to choose as the reply parent, and instead just put the post on the top level. In this case (as in the majority) the replying user didn't use the referencing button, but just inserted @<Name> (instead of @<Name>/<Nr>, which is generated by the button).

Another example of an unanticipated (but, in this case, not undesirable) use of the @<Name> pattern is a level four post in which the author references the direct parent on level 3 and the parent's parent on level 2.

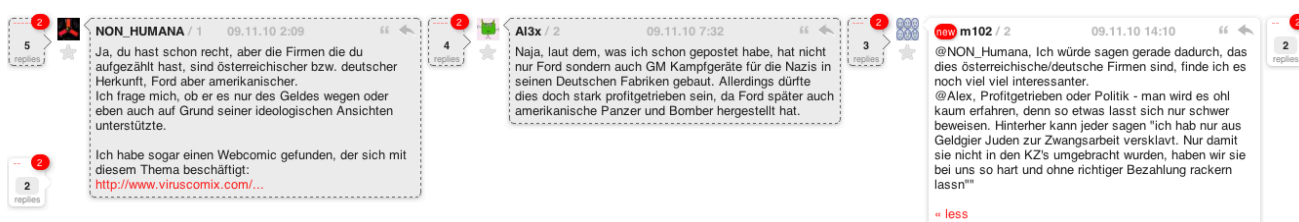


Fig. 43: Referencing of the parent and the parent's parent.

This is a pattern that is commonly found in threaded discussions on traditional BBSs. Along with the previous examples, however, it indicates that users do not know or do not value the referencing functionality.

It is worth noting that in *discourse*, the referencing was much more vital because dialogues embedded in a longer list of sub-level posts had no other indication of their threading.

7.2.2 Ratings

The ratings system of *discuss* is the same as in *discourse*: Users can award a star to a post they find very valuable. The number of total stars received is then displayed next to each post.

7.2.3 Discuss and Criteria for AOD-based learning

Discuss shall also be measured in terms of how well it fulfilled the criteria for successful AOD systems (with a focus on the potential for learning) outlined in 3.4.2.

Putting the AOD to situated use. The *slidecasting* system included discussion prompts with links to the according discussion topics. A discussion was therefore (like in *discourse*) always directly linked to a particular slide, i.e. a specific fact, question, or concept.



Fig. 44: Informative posts receive stars.

Supporting symmetry, commonality and interdependency. The students' accounts in *discuss* are tied to their university-wide accounts. They cannot disassociate themselves from their unique university ID, but if they change their username only administrators (professors, tutors, staff) are able to make the connection with their ID. Most users quickly changed their username to something that does not hint at their identity, resulting in symmetry, anonymity (towards each other) and accountability (towards administrators). Basic peer and formative assessment was provided and used: Students gave each other "stars" and administrators gave "admin stars", the same mechanism, but internally marked appropriately. Students typically give stars for very informative posts, as in the example shown in Fig. 44, where the poster explained a certain mechanism for generating and memorising secure passwords. All posts in *discuss* can be edited by their authors after they have been posted, without any required indications of the edit visible to other users. The e-learning context and personal accountability make it unnecessary to prevent misuse through stronger limitations.

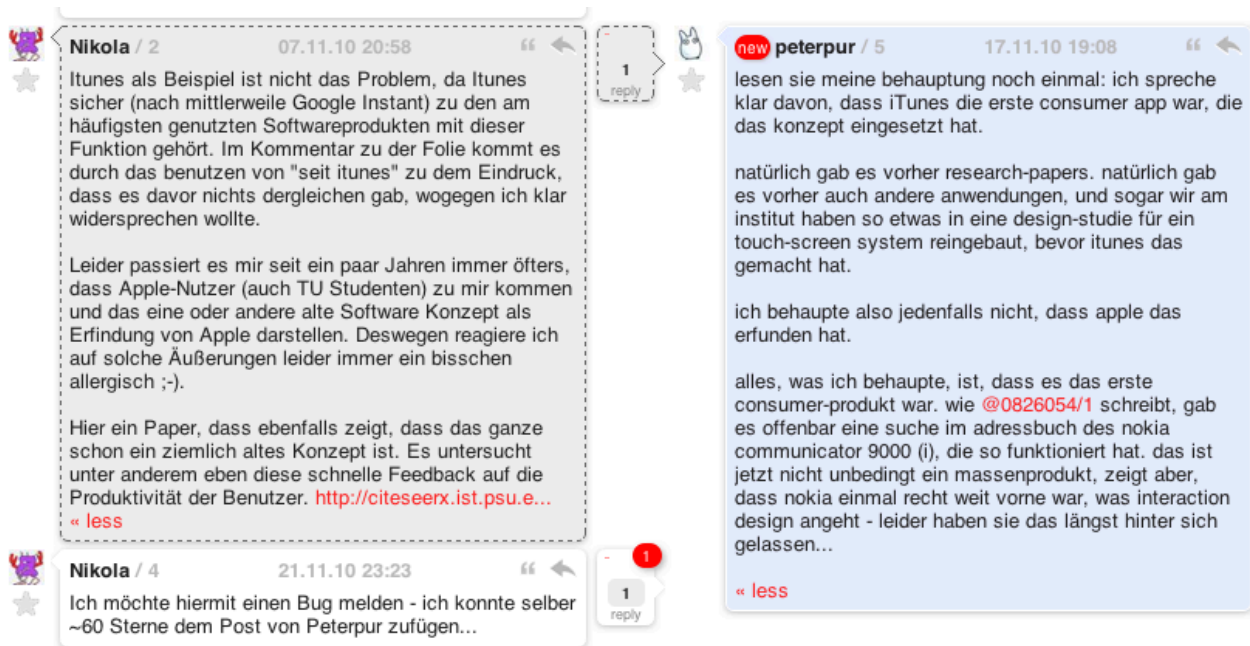


Fig. 45: The moderator summarises information.

Offering tools to structure and facilitate the discussion. All moderators are administrators in *discuss*. That means that their posts are highlighted in a different colour, they can change or remove posts and give “admin stars”. In the example in Fig. 45, the moderator also used the referencing functionality to summarise information of the post he replied to and a different post on the same level.

Heightening intrinsic motivation. E-mail notifications, RSS feeds and read/unread indicators help keep the users updated on activity in their discussion groups. The amount and (generally high) quality of participation shows that the system did well in supporting intrinsic motivation.

Grounding. The low amount of “@<Name>” references, but (compared to *discourse*) high amount of sub-discussions indicates that the visual structure itself facilitates grounding well enough.

Multi-voicedness. Text formatting is limited to paragraphs and automatic link markup, but these tools allowed the users to generate generally very readable and structured responses. Multiple paragraphs were commonly used to separate different aspects of a response.

Multiple references. Referencing is discussed in section 7.2.1.

Time management. Typically, discussion prompts generated about 80% of the responses within the first two days after they went online. In several cases, an author of a top-level post

replied to a reply of that post within 24 hours. When, as in this case, discussion is part of the graded participation in a lecture, time management is always dependent on the deadlines, but the high activity in a discussion while it is the newest indicates that it is manageable to stay connected to the activity.

Complexity management. As mentioned in 7.1, *discuss* has, in general, a lower number of top-level posts and a higher amount of posts in sub-discussions, keeping the complexity of the top level manageable. Furthermore, the progressive disclosure of posts does not overwhelm the reader – fewer top-level posts make it more likely that the user reads all of it and looks at the sub-discussions of the most contributions which are most interesting to them.

Summative assessment. In the version described, the functionality facilitating summative assessment was limited, but the rating system and the depth information of contributions makes a variety of filter criteria for a user's posts possible for future iterations.

Formative assessment. Admin ratings are implemented and used; private messages (for more detailed feedback) are possible through the *dashboard* framework.

Peer assessment. Peer rating via “stars” happens, but is not particularly common. More rating might be induced by the introduction of a feature that shows a selection of highly rated posts across discussions. This, however, would have to be reconciled with the separation of users into discussion groups.

7.3 Feedback from the department

As the participation in *discuss* was used as one form of student assessment in “Computer Science and Society”, Prof. Purgathofer was able to judge the success of the system in the context in which it was used. His general impression regarding some of the main concerns with *discourse*:

We had hoped that [...] when two of them really get at each other like two pitbulls, which often happens in discussions, they don't ruin everything for others... That should then become just a chain that's collapsed, and one can see, ok, they did it again, but I [as a user] am not necessarily interested in it. [...] The other thing was that people would read more and react to each other more instead of just posting themselves, so that there are fewer redundant posts, and fewer people just say what they think. And I feel, without having evaluated it, that it worked pretty well. I think that the discussions were more varied in their answer structures, but in total there were fewer posts, that's my second impression.

(P. Purgathofer, personal interview, 22 June 2011; my translation, P.H.)

From the student perspective, the primary reaction was surprise about the unusual format of *discuss*, but no specific complaints. Likewise, no one reported trouble with the use of the system (ibid.).

But how did the teachers use the system?

One could see clearly what was new, with the red badges [...] The great thing was that through this two-dimensional structure our spatial memory was activated [...] When I came back to the discussion after a week and saw that there were five new things, then I unfolded it and I realised, "Ah, that was that", because I already saw from the structure and size of the postings where I was. And that's something that I hadn't foreseen, that this spatial thinking - which is a strength of human perception - is supported so well, or that it helps remember where things were.

(ibid.)

The teachers would then award "admin stars", similar to peer ratings but grade-relevant, to posts they regarded as very informative or useful. In this process there was one thing that *discuss* couldn't provide:

People wanted to know whether we had already looked at their posts. They said, "I posted something good and didn't get a point for it." And there was no way to tell them that we had already looked at it but that it's not worth a point. But it's really difficult, and I don't know how we could solve that.

(ibid.)

The most significant improvement of *discuss*, for Purgathofer, was how easily one could find the new (unread) posts, followed by the ability to quickly glean the discussion structure from the sparklines. One common problem, on the other hand, was that people would often post something as a top-level post even though it should have been a reply. Purgathofer points out that might help to change the way the text field for top level posts is displayed right below the last top level post. An alternative would be to allow the moderators to move posts to where they think they belong, and to get people to learn that way. (ibid.)

In general, Purgathofer – and other members of the department who were involved, such as the teaching assistant who assessed contributions – liked *discuss* and would have it included in future iterations of the e-learning framework.

8 Conclusion

Discuss is an attempt to rethink and improve something that has proven to work reasonably well in a wide variety of applications. The most important change, the different visual structure of an AOD system, has turned out to be a good fit for the context in which it was tested. The primary intended effect on the structure (the shift of sub-discussions to initially invisible tree branches) has been achieved, with some exceptions in which users behaved differently than desired.

The additions in visual metaphors and indicators for the amount and type of activity have been of varied success: The “new”-badges and reply indicators were easy to read, but the sparklines could not be visualised in a way that made sense to the majority of users.

The referencing functionality was hardly used. This is unlikely to stem from poor communication of the feature, but rather from the habit of users to rely upon a learnt convention of addressing other posts manually via typing “@<Name>”. The cases in which this pattern would not suffice, or in which it would be very inconvenient, were so rare that the additional convenience of the referencing button was never really required.

This last point is interesting, as it indicates that insofar as purely a visual ordering of discussion threads is concerned, users are willing to adopt new metaphors very quickly. The referencing functionality, though, could have supported cross-referencing into different sub-discussions, engendering an almost circular structure. This, however, did not happen at all. It can be concluded that in order to observe fundamental differences in the structure of AOD, the system would have to require or reward new discussion patterns more strongly, rather than just enable them.

With or without this functionality, *discuss* is a successful leap away from “hermeneutic extrapolation” – one of the most encouraging proofs for this is the fact that new patterns emerge, such as the use of spatial memory to find parts of discussions, which were neither planned nor possible with too close an orientation on the old structures derived from linear notions of written conversations.

Discuss was designed to address the requirements of e-learning in a time in which connectivism is, arguably, the dominating learning paradigm, especially for technophile users such as students of computer science. Because of this, its ongoing integration into a capable framework that encompasses other tools, such as the aforementioned *slidecasting* or the asset management

module *portfolio* is essential. However, taken out of the context of e-learning, the essence of *discuss* – new visual structure, real-time updates, condensed meta-information via infographics, tools for managing complexity – can still be applied to any situation in which an AOD system is required. It will not fit all contexts equally well (alone because of its heavy use of horizontal space), but it can serve as a basis on which to continue thinking about the organization of online discussion.

The outcome of the project, however, was more than a system that fulfilled a purpose and made some interesting improvements to traditional concepts: The result is not just a software system and a document that describes it, but a case of successful research by design. As we have seen, the relevant theories may give us a wealth of background knowledge some of which can inform decisions or help interpret unexpected results. But for some behaviours and problems, the theories may have no answer. Instead, a variety of empirical evidence, gained through design experiments, can lead to new theories and ideas. Although the theory and practice sections are clearly separated in this document, in reality they overlapped, and in a field focussed on human machine interaction, especially when the system to be developed serves the purpose of direct communication between people, the fact that no theory can reliably anticipate the full range of human behaviour makes research by design the most valuable tool. The knowledge gained from developing and testing *discuss*, as documented in this text, can hopefully also be of use for tasks far beyond developing AOD systems.

9 Future Work

There are some clear changes that need to be made to *discuss*.

First, the system needs to be better integrated into the existing framework. As indicated above, the future of the framework is currently unclear, but if it is reactivated, *discuss* will be seamlessly integrated.

Second, the referencing functionality is not needed. If the proportions of the system are changed significantly, a quoting mechanism (such as in vBulletin) could be considered, but in the present dimensions, referencing is addressed well by traditional forum conventions, without a special mechanism.

Third, the sparklines need to be changed so that the information they hold is accessible to the user. One option is to sacrifice additional space for a larger and possibly annotated variant of the current graphics.

A feature that has been discussed but not fully implemented is a categorisation of posts: Every post could then be marked as an “idea”, a “fact”, a “question” etc. This is a feature already present in some systems and can help to increase the amount of information one can glean quickly.

Finally, there is a wealth of functions – such as various statistics views or direct messaging from within *discuss* – that are essential for a polished system but were not considered before the core functionality was tested sufficiently.

While *discuss* was informed by the premise of connectivist learning, current web technology allows an even stronger emphasis on enabling the quick connection of knowledge. More reactive tools such as instant search (displaying results as you type), pop-over page previews for links, and integration with third-party online social networking tools could be integrated into *discuss* - as far as is appropriate for the non-public educational context - to make it even easier to navigate to and from the discussions.

It is most interesting, however, to see that the experiment of changing the metaphor for a tree-shaped discussion structure was successful. This hints at even greater potential for introducing new visual structures into AOD. The continuous changes in web standards, connection speeds and device capabilities could inspire continuous experimentation. While *discuss*

primarily attempted to provide the optimal layout for certain screen space conditions and to emphasise the tree structure of conversations, one could try to move even further away from a linear structure by, for example, allowing multiple parents for a reply. Another possibility is a stronger specialisation for a particular type of discussion or a specific way of interacting with each other's texts.

Discuss has the potential to become a module for use outside of educational contexts. In that case, some features that worked in the current form because of the environment of the system – such as searchability with third-party services or post editing – would have to be reconsidered, changed or extended.

Discuss can be taken in many directions – but primarily, I hope that it will be an inspiration for future attempts to gradually diversify the metaphors that allow us to talk to each other on the internet.

10 Appendix

10.1 Acknowledgements

Discuss is a collaboration with Prof. Peter Purgathofer, who envisioned, initiated and guided the project and contributed many of the core design ideas. I am very grateful for the productive design process and for entrusting me with such an interesting project.

Discuss also became part of a suite of e-learning modules which were and are developed by Martin Sereinig, Naemi Luckner and Michael Emhofer. Their technical support made it possible to ensure a smooth interaction of *discuss* and the modules *dashboard*, *portfolio* and *slidecasting*.

The design could not have been brought to a point at which it was ready for a production setting without the help of the staff, teachers and students of the HCI group, who participated in several test discussions of prototypes at various stages.

Finally, neither *discuss* nor this paper would exist without the support of my family and friends, in particular Hannah Shepherd, who, on top of all the emotional support and feedback on design problems, provided invaluable assistance with the editing of this document.

10.2 *Discuss* Availability

At the time of writing, *discuss* is active as part of the e-learning framework at the Department of Design and Assessment of Technology (HCI Group), Vienna University of Technology, in two versions: First, the version used for teaching in the winter semester 2010/11. This version is only accessible with a valid student account at Vienna University of Technology. Second, a development version where testing and integration takes place.

Both versions are hosted by the department and are not open to the general public at the time of writing.

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10.4 Figures

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All online resources were last accessed on 1 July, 2011.

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