Layout Considered Harmful: On the Influence of Information Architecture on Dialogue

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Abstract. Discussions are an important tool for students to engage with new content, bring up new ideas and generate knowledge. This paper focuses on the representation of asynchronous online discussion forums in an e-learning context and how it influences the outcome of discussions. We compare the results of a traditional discussion visualisation - a vertically threaded comment system - to the two dimensional system *Discourse*, in which every new statement of the discussion opens a new subthread. We draw our conclusions from a qualitative analysis of pairs of discussions on the same topic conducted in both systems. Our findings suggest that discussions in *Discourse* are more focused and goal-oriented than in traditional threaded system.

1 Introduction

It has been found that discussion systems increase critical thinking skills [1], facilitate educational dialogue and provide a means for feedback between students and instructors [2]. Students can actively participating in debates, contribute and gain new knowledge from others [3]. In asynchronous discussions students have time to research and formulate their arguments, which leads to a high quality of the discussion [3]. Other projects have tapped into the wide range of possibilities posed to educational purposes by online discussions ([4], [5], [6]).

As of yet, there is not much literature on the topic of representations of collaborative learning discourse, and their impacts on the outcomes of discussions. Suthers [7] describes different forms of online discussions and compares their influences on the way discussions are lead. Popolov et al. [8] analyse existing discourse representations and point out their flaws, as well as suggests possible new designs. More generally, Wright has written about the psychology of layout [9]. She discusses how layout influences the effort it takes to use read information, the influence of layout on the willingness to read, on readers' assumptions and on reading strategies. Even though she is not referring to discourse layout in particular, her general observations apply to collaborative discussion interfaces as well. Dyson [10] generally describes the effect of typography and layout on reading from screens. Middlestadt and Barnhurst [11] found that different layout changes the perception of the content of newspaper articles and reader's attitude

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towards them. The layout of the *Discourse* system has already been discussed in [12].

Discourse, the redesign for online discussions, derives its inspiration from the *Infinite Canvas* concept introduced by Scott McCloud [13]. Traditional representations of online discussion rely on one dominant dimension (in most cases the vertical dimension Y) to represent the flow of postings.

Discourse uses both available dimensions to structure and present information. Each new statement in the discussion is listed in a column to the left of the screen. Replies to these statements are arranged in columns to the right of the statement. As each of these replies can be replied to, each one can have a column of replies associated with it. The principal structure of the presentation of comments and replies can be seen in Figure 1.

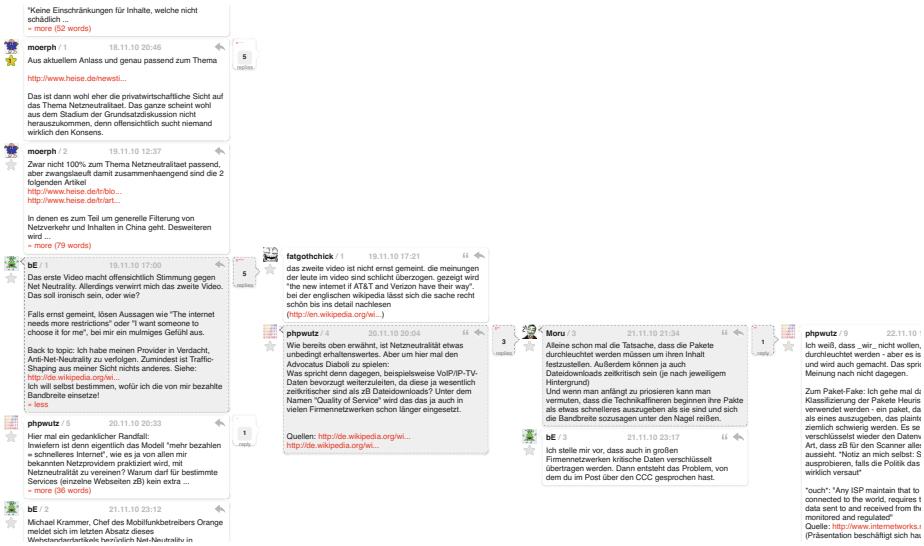

Fig. 1. Selected items have a dashed outline and are shown with a grey underlay, indicating that the column next to it displays replies to the selected item

In this paper, we are comparing two threaded discussion systems that were used in a university lecture in two consecutive years. The remainder of this paper is structured as follows: The next section 'Similar structure, different layout - two threaded discussion systems' offers a detailed description of both discussion systems. The section is followed by a 'Setting and method' chapter describing the approach and setting in which the data was collected and evaluated. In the chapter 'Evaluation and discussion', the quality of discussions across the two systems is compared using qualitative content analysis according to Mayring [14]. Comparisons are drawn between discussions held on identical lecture topics in the old system in the first year, and in the new system in the second year. The paper closes with a 'Conclusion' chapter, summarizing the findings.

2 Similar Structure, Different Layout – Two Threaded Discussion Systems

Both discussion systems are embedded in an online learning support system used at the Vienna University of Technology. The system is comprised of various modules like an organizational Newsfeed, a section for lecture slides and comments to the slides, as well as a portfolio section for each student. A detailed description of the system can be found in [15].

The system used in the first part of the evaluation was a one dimensional threaded discussion system embedded in the lecture slide view, that featured only one level of indentation (see Figure 2). Discussions were started with a top-level posting, outlining the topic and including statements or questions the students could reply to, all in the context of the respective slide. Students could either respond directly to the top-level posting, or start a new thread beneath it. Replies were arranged vertically under each thread in their chronological order. Within threads, replies could be directed at the first posting of the thread as well as at other replies. To convey the affiliation of a reply to another persons post, students could refer to it, using tags like *@username*. Hence, the whole discussion was represented vertically on two levels: top-level postings, and indented replies, notwithstanding more complex relations between the content of postings.

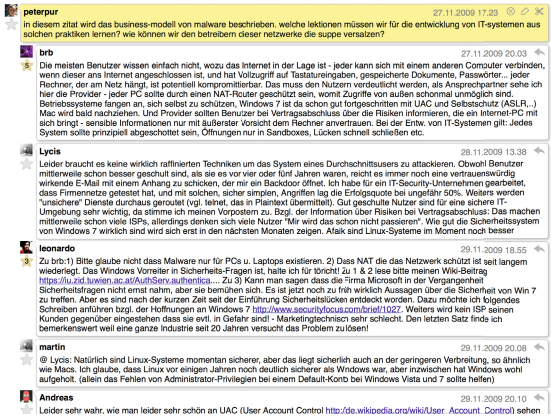

Fig. 2. A one dimensional threaded discussion with one indentation level. Referring to other postings within the indentation level is done by mentioning the other persons username at the start of the reply.

The second system, *Discourse*, was not integrated in the slides section but worked as an independent module of the online learning support system. Students could either navigate to the *Discourse* section directly, or via the discussion starter that was still attached to a slide in the slides section, but now only serving as a link to the *Discourse* module. The link lead directly to the chosen

discussion, while navigating to the discourse section showed only an overview of currently running discussions. The overview provides students with information about currently running discussions and also if there have been new, unread postings in discussions the student is currently involved in.

The multi-threaded discussions are represented in two dimensions. Students are encouraged to post new thoughts and ideas that have not been discussed yet as new top-level postings in the discussion. All top-level postings are represented as a vertical list in the second column on the page, with the first column consisting of a thumbnail of the slide, and the discussion starter. Whenever a students logs into a discussion, these two columns are visible. If replies to a posting exist, an information box appears next to the comment, containing the amount of replies that exist in this thread; how many of these replies the participant has not read yet; and a spark-line representation of the further structure of the thread. Each element in the spark-line represents one level of responses to a comment, with the amount of bars showing how many replies postings are in this level on average.

To read a thread, it can be unfolded by clicking the information box. Students can either unfold the whole thread at once, or navigate through it, layer by layer. All postings, including replies, can be replied to. Each reply is displayed in the column immediately to the right of the posting. For example, a thread that started with a top-level posting followed by an interplay of single replies is represented as a horizontal string of postings. Only one thread of the discussion can be open at the same time. To keep track of which comment thread is open at the moment, the active comments have a grey background for accentuation. A more detailed description of the *Discourse* system can be found in [16].

3 Setting and Method

We had the suspicion that a layout differing in key characteristics from the traditional format could influence the way discussions are held online. In order to evaluate the impact of such a design, we used different systems in two successive years to facilitate participant discussions in a university course in the area of 'Informatics and Society'. In both years, we asked the respective students to participate in identical discussions, against the background of an identical lecture [1] held by one of the authors of this article, Peter Purgathofer. The course is offered as part of the Informatics Bachelor programs at the Vienna University of Technology, and is mandatory for all first-year students in the second semester. Participation in the discussion was voluntary, and general discussion was welcome. To promote substantial participation, students were offered points toward their grade for individual contributions of high quality.

In the research discussed in this article, we focussed on evaluating the interaction between students as well as the discussion as a whole, rather than e.g.

[1] 'identical' - Of course, the content of a lecture in 'Informatics and Society' has to reflect current events and trends; Still, for the purpose of this comparison, the lectures can be assumed sufficiently identical

collaboration or community structure within our system. In her paper, Meyer discusses different methods of discussion evaluation: content analysis; rubrics; and frameworks [17]. The analysis of the presented system was done using qualitative content analysis, following the approach laid out in Mayring [14]. While we also applied some quantitative criteria to more directly compare the differences, we think that the qualitative analysis makes the influence of the different systems much more explicit.

Coding and categorizing the postings was done by the two authors independently, and in a second step the evaluations were compared. Since the interpretation of meaning in latent content is a subjective process, bias cannot fully be avoided. This two-step process was chosen in order to produce reliable results and lessen inaccuracies of the evaluation introduced by subjective interpretation of the postings. In the first step, all postings were read, and a classification was developed based on the content of the postings and the relation of the postings to each other. This classification is shown in table 1. In a second pass, we coded all postings following this classification, and additionally asserted in which way they related to the respective preceding posting, i.e., supportive, oppositional, or neutral . Finally, the structure of the discussion was visualized in a directed graph with type of each posting instead of the text in order to better understand the flow of discourse.

Table 1. Coding: This table shows a list of possible posting types and their explanation

Category	Semantic	Example
Statement	A posting where facts are stated and/or external sources are quoted.	'Bill Buxton states that?'
Opinion	A posting where the author gives her opinion on the matter, without specifying sources.	'I believe we have to?'
Question	In such a posting, the author openly poses a question into the discussion.	'Can it really happen that?'
Answer	Such a posting can answer an explicit question, or refer to issues left open implicitly in a statement or opinion positing.	'Yes, it is indeed possible that?'
Materials	Such a posting adds sources and/or other materials relevant to the discussion.	'You can find more information at?'
Example	The author introduces an example into the discussion.	'Where I work, people usually?'
Clarification	In such a posting, the author tries to clarify an unclear or open issue in the preceding positing.	'To sum it up, I would say?'
Insight	Here, the author expresses a realization of something that was hitherto unknown to her.	'Ok, i see your point.'

The posting types themselves are more or less self-explanatory, and are described in Table 3. In the structural visualizations, each posting is represented by its respective posting type. To visualise the argumentative relation of postings, we use an arrow, pointing either upwards or downwards. Posting supporting the preceding posting are indicated by an upwards arrow; postings contradicting the preceding posting are indicated by a downwards arrow. Some postings are neutral, which usually means that they don't really respond to the preceding posting and can be considered a non sequitur.

Finally, we color-coded postings by author and posting frequency. For the printed version, all postings of the author who contributed most to the discussion in terms of quantity are indicated using white type on a darker gray background; postings by authors who contributed more than once to the discussion have a light gray background; and postings by authors with only a single contribution are shown with a white background. Also, the discussion starter is highlighted with white text on a black background. This makes any differences in repeated participation between the two representations quite obvious[2].

4 Evaluation and Discussion

We applied this evaluation on five discussions held both in the traditional forum format in the first year and *Discourse* in the second year. Due to practical constraints, we can only show the results of one evaluation in this article in detail. All five evaluations can be examined in detail in the complimentary online section[3] of this article.

Figure 3 shows the structure of a discussion on *net neutrality*, facilitated with the old forum system. In the discussion starter (labelled 'initial statement + questions' in the visualizsations), participants were asked to watch an anti-net-neutrality commercial from the National Cable & Telecommunications Association[4] and a pro-net neutrality ad from Google[5], and read a (then recent) online document[6]. Participants were then asked a couple of questions, initiating a discussion of the theoretical value and the reality of net neutrality.

Using the plain forum format, the resulting discussion comprised of 35 replies, submitted by 34 students, an average of just 1.03 posting per participant. A single student wrote two postings, whereas everybody else stopped after posting a single entry into the discussion. Interaction was the exception rather than the norm; only 10 postings, less than 30%, were written in response to what somebody else wrote. 21 postings are completely isolated, meaning they don't

[2] For the complementary online version of the same visualizations, the postings of each author are shown in different colors

[3] `http://igw.tuwien.ac.at/designlehren/discourse_evaluation.html`

[4] `http://www.youtube.com/watch?v=oPIYxtjLFeI`

[5] `http://www.youtube.com/watch?v=o9Dv8OnIwmc`

[6] The Verizon-Google Legislative Framework Proposal, `http://www.scribd.com/doc/35599242/Verizon-Google-Legislative-Framework-Proposal`

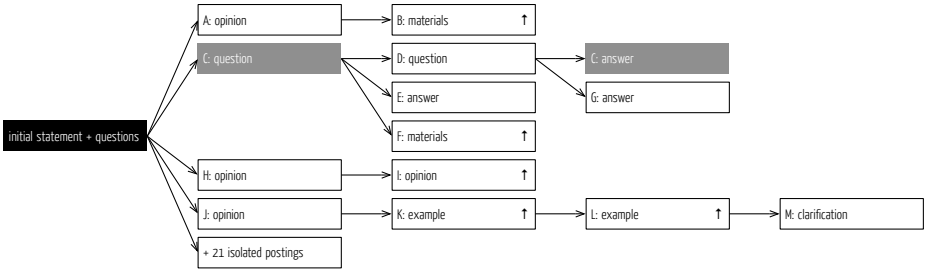

Fig. 3. Discussion on net neutrality using the plain forum format. The black discussion starter was posted be the course instructor. Posts from the user with most contributions are dark gray. All posts from users with more than one contribution are light gray.

refer to any posting other than the 'initial statement + questions' posting, and are not referred to by another posting. The distribution of the 14 non-isolated postings is shown in Figure 5.

Counting the links, the single longest chain of discussion is 4, while the average length is 2.6. 50% of all postings within these discussion threads and 80% of all postings are end points in the graph, that is, they are not replied to.

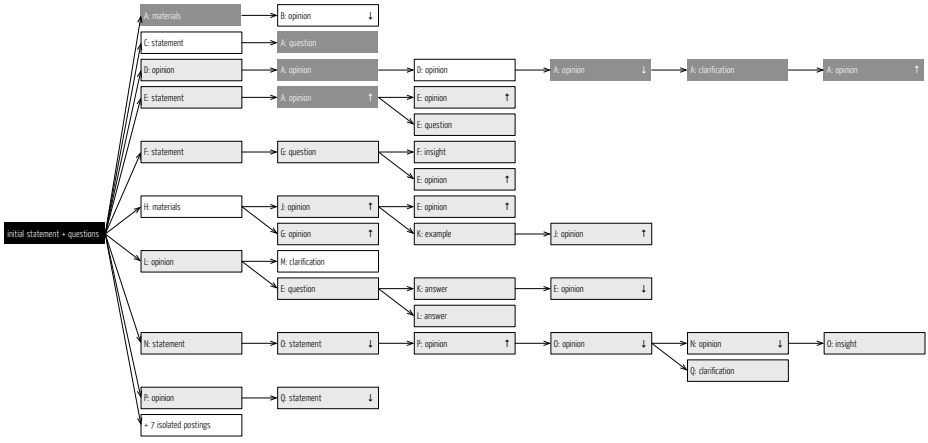

Fig. 4. Discussion on net neutrality using the *Discourse* system. The black discussion starter was posted be the course instructor. Posts from the user with most contributions are dark gray. All posts from users with more than one contribution are light gray. Please note that due to recent changes in html/css rendering, some elements are slightly misplaced from their intended position.

Using *Discourse* a year later, 20 students participated in the discussions, writing 46 contributions. This constitutes an average of 2.3 postings per participant - much more than in plain forum version. Of these, only 7 postings were isolated,

while 39 postings were either replies to other comments, or being replied to by somebody else. This alone constitutes a much higher rate of interaction between the participants. 30 comments, or 65%, were written as a response to another posting.

The longest chain of discussion is 6 postings, with the average length being 3.31 postings. 41% of all postings within these discussion threads and 50% of all postings are end points.

Figure 5 shows the difference in the frequency of the types of comments in each system. Using this approach, three differences become evident.

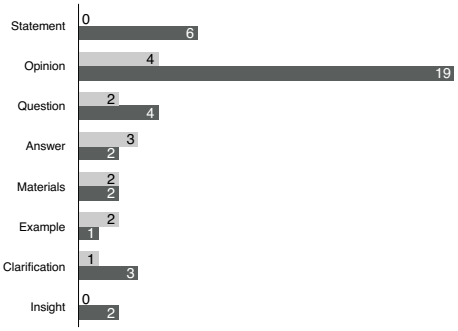

Fig. 5. Occurrence of posting types in both the traditional forum system and *Discourse*

- 6 statements were posted (as compared to 0 in the plain forum version); writing a statement is more work than writing an opinion, this implies a higher rate of engagement than in the plain forum.
- At the same time, 19 of the 39 non-isolated comments were opinions, 16 of which were written as a reaction to other postings. While writing an opinion as a response is much less work than writing one of the more substantial posting types, it indicates a higher rate of reading and involvement than the plain forum version.
- 3 comments were categorized as insight in *Discourse*, versus 0 in the traditional system. A possible explanation for this is that it is a direct consequence of the longer chains of discussion in *Discourse*, which in turn can be seen as an indicator for more involvement in the discussion.

The visualisations of the discussions using the codified posting types invites a number of further observations:

- In the discussion using the traditional forum system, participants never openly oppose each other, while in *Discourse*, we can identify multiple singular instances of opposition. Even more, we can see participants answering to these oppositional stances, even leading to insight in the end. One could argue that this is what open discussions are about: critically reflect and reconsider one's point of view.

- The large number of isolated posts in the traditional view suggests that many participants coming late to the discussion had no incentive to read through the discussion so far, and ended up posting their own opinion or statement without regard for what other participants wrote. The much more structured *Discourse* system invited people to first read what others wrote before posting something.
- While most participants in the traditional forum system posted only a single contribution, most postings in *Discourse* came from students who wrote more than one contribution. This again shows that the rate of interaction with the discussion was higher than in the traditional system. The results of the analysis of the other four discussions confirm these results.

5 Conclusion

Our evaluations show that the discussions facilitated with *Discourse* display improvements in a number of essential qualities compared to the discussions done in the admittedly quite simple, but still very common single-thread system. While we cannot really shed light on why this is the case, we can formulate a number of hypothesis to explain the effect. Whatever the real reasons might be, we think that all of these hypothesis point to advantages of *Discourse* over traditional online discussion layouts.

- The much higher demand for interactivity in *Discourse* leads to a feeling of more agency. For example, *Discourse* forces participants to make a decision whether to follow a thread further, or to ignore it; this choice fosters involvement.
- Traditional forum layouts suffer from 'context blur'. For example, a feud between two participants pushes all prior replies away from it's 'parent', making more substantial replies much harder to find. Often, when reading long discussions in a traditional threaded format, it is challenging to remember which posting a reply refers to. In *Discourse*, it is much easier to see and understand the local context of a postings, i.e. it's 'parent' and 'siblings'. A feud is simply a long horizontal chain of postings, and can be ignored much easier. This overview gives participants a better chance to find the place and posting they want to respond to.
- The relatively low number of first-level-postings in *Discourse* makes it easier to catch on with an ongoing discussion. This in turn motivates participants to find a place to respond, rather than just deposit their opinion.

This list is neither exhaustive nor sufficient to explain the reasons why online discussions can be elevated simply by layout and interaction alone. Still, we think that our observations support the assumption that the role of information architecture and interaction design of ICT systems goes way beyond the mapping of functionality onto a simple to use interface.

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