

Integrating Discussion and Summarization in Collaborative Writing

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81% of this page summarized

Proposal: Improving dining options at or near MIT

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benchmarked. Need to breakup the catering/grocery monopolies dominate the campus.
 4. Include more food trucks at MIT.
 5. Introduce more kitchens in the new dorms.

Respectfully,

Users of <http://128.52.139.135/>

Summary edited by anon12, anon1, anon123, anon1234, anon3

Summary

The options we believe to be most viable for 2020 are
 1. Implementing the online meal ordering station within dining halls.
 2. Replacing the missing Subway in the stud with something else.

However, we still believe that benchmarking the prices of groceries in La Verdes, potentially even opening up a new grocery store, and increasing the diversity and quality of food options near campus are crucial to the well being of students. These are longer-term solutions and require more logistical planning.

Summary edited by anon123

Comment by anon12

Does anyone know what the Subway location at the stud is now used for?

Comment by anon12345

Pretty sure they just plastered over the wall

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Abstract

In many instances of collaborative writing, ideation and deliberation about what to write happen in a separate space from the actual document writing. However, having discussion and writing separated may result in a final document that has little connection to the discussion that came before. In this work, I build upon a hybrid discussion and document-writing tool called Wikum+ to allow groups to mix having discussions and summarizing those discussions in real-time, until the process results in a final document that incorporates and links all discussion points. I conduct a pilot study where a group used Wikum+ to collaboratively write a proposal, while a control group used a messaging platform along with Google Docs. From analyzing survey and interview results, I found preliminary evidence that Wikum+'s integration of discussion and summarization helped users be more organized as well as more inclusive of ideas in the final document. Wikum+ allowed for more light-weight coordination and iterative improvements through the incorporation of new ideas.

Author Keywords

online discussion; collaboration; summarization; writing

CCS Concepts

•Human-centered computing → Web-based interaction; Collaborative interaction; Synchronous editors;

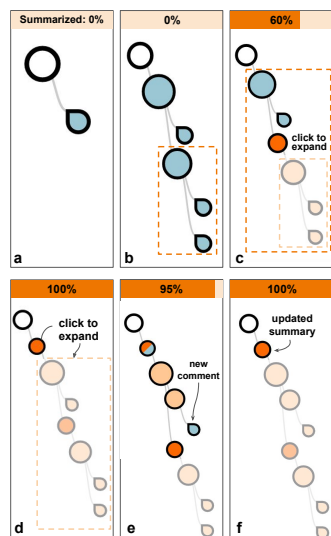


Figure 1: Wikum+ discussions grow with discussion & shrink with summarization. By default, only summary nodes and unsummarized comments are shown, unless summaries are clicked-to-expand. Workflow: (a–b) Users contribute new comments and replies. (b–c) Users can summarize select comments, adding an orange summary node and changing the blue (unsummarized) comments to yellow (summarized). (c–d) Summaries can be added at a higher level that include other summaries recursively. (d–e) Users can add new comments at any point. Summaries above such comments turn half-blue, half-orange to signify partial summarization of comments below. (e–f) Users can edit the partial summary to incorporate new comments. Steps (d) through (f) loop until the summary reaches a stable state.

Introduction and Background

Cooperation and the sharing of ideas in team production have been shown to have social benefits for groups as well as better and more innovative outcomes [4]. Furthermore, the perceived quality of collaboratively written documents is higher [1], overall productivity increases [3], and interpersonal relationships are enhanced [10]. Today, online discussion platforms provide a liberating medium for groups to collectively interact, ideate, and deliberate across time and distance. However, a major challenge for collective deliberation that is exacerbated in the online setting is refining and combining the mountain of ideas into something meaningful [2]. Large groups tend to develop large amounts of shallow and redundant ideas and have trouble deciding on and selecting a set of good ideas [2, 9]. Moreover, interesting comments and the outcome of deliberations can be buried deep in or scattered throughout online discussion threads, whereas other comments may be controversial, off-topic, or problematic [9]. Users must sift through repetitive and low quality ideas, worsening the creativity of their own contributions and their overall productivity [11].

Many online collective deliberation systems currently rely on filtering, voting [6, 7], a single or few moderators [8], or polls and surveys [6] to pick the best ideas. Unfortunately, these methods can reveal biases as well as suppress minority opinions, due to reliance on moderators or under-provision of votes [5]. In addition, voting systems have no capability for more sophisticated *refinement* to improve an idea or *synthesis* of multiple ideas. For instance, some competing ideas may be impossible to combine while others become stronger together.

These issues all make the task of writing up a cohesive plan or document from a discussion more difficult. In addition, the lack of synthesizing capabilities on common online discussion platforms result in users having to move to

document-writing software. By migrating away from where they had discussion, users lose the ability to directly reference conversation or easily incorporate what people said. Some software such as Wikipedia have space for discussion but it lives on a separate page and cannot be referenced in the main document. Additionally, collaborative document-writing tools like Google Docs have features for chatting and in-line commenting. However, there is no easy way to connect chat messages to document edits, or to start from a discussion and build to a document section.

Wikum+: Integrating Discussion and Writing

In this work, I present a system that allows for the steps of collaborative ideation, deliberation, synthesis, and document-writing to happen in one space, so that users can move seamlessly from one step to another and back as necessary, and ideas maintain their provenance as they move from original comments all the way to their incorporation into the final document. The system is developed on top of an open source software tool called Wikum [12]. On the original Wikum, users can import a concluded conversation that has happened elsewhere, such as Reddit or Disqus, and collaboratively summarize it in a *recursive* fashion, by summarizing small portions of discussion and then summarizing the summaries, until the entire discussion is summarized into a *summary tree* (Stages (b) through (d) in Figure 1). This explorable summary tree allows users to identify and explore the main topics of discussion [12].

However, Wikum assumes that all discussion on a topic is completed before any summarization commences. Users could not add new comments and could only summarize the existing imported discussion. But it is common for collaborations to require multiple stages of deliberation, action, and then reflection and further deliberation of those actions. New ideas and re-considerations may also come at different times. In order to integrate discussion alongside the sum-

User Study Writing Task

- Why current dining options are problematic
- Comprehensive list of dining solutions
- Cohesive & convincing argument of best 1-2 options from list
- Trade-off analysis of selected options
- Proposed timeline on how to implement options by 2020

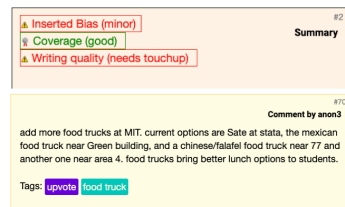


Figure 2: Users added flags to evaluate summaries and point out areas that needed work. Users also used tags to help with skimming and grouping.

marization in Wikum, I implemented the following additional features to create Wikum+. **First**, I implemented the ability to add comments within Wikum. This includes adding comments and replies to a new, unsummarized discussion (Figure 1(a)) as well as comments in reply to summaries and discussions that have been already summarized (Figure 1(e)). As seen in (e), Wikum+'s visualization now shows when a summary is out-of-date due to newly-added comments. Users can also update a summary to incorporate new comments, which removes the out-of-date indicator (f). **Second**, Wikum only supported asynchronous editing. While acceptable for summarization, synchronous editing is necessary when rapidly ideating or deliberating. Wikum+ now supports real-time updates for all actions, such as commenting, tagging, flagging, and summarizing. To prevent potential race conditions, I introduce locks so that no other user can interfere while a user is writing a summary for a particular selection of comments. However, other users are still able to simultaneously summarize any other subset of comments. After completing or fifteen minutes of inactivity, the lock is released.

User Study

While Wikum+ permits fluid interchanging and integration of commenting and summarizing, it's unclear what effect this has on the quality of collaboration. It is also unclear how groups will use the tool. Will users resort to discuss-first, summarize-later or make use of the ability to go back and forth? How does this differ in synchronous versus asynchronous settings?

I conducted a pilot study with two groups, one using Wikum+ and one using a control. The study had two parts, including a 30-minute synchronous portion, and a 3-day asynchronous portion. In both the short and long portions, users in the Wikum+ condition (4 males, 2 females; mean age 21) could only communicate through Wikum+ and users in the

control group (2 males, 4 females; mean age 21.5) could only communicate over Facebook Messenger and within a shared Google Doc. The Wikum+ group received an additional 15-minute training and a Wikum+ guide to learn the tools and interface that Wikum+ provides. Users are students at a U.S. university and received \$10 for participating.

Users were given the task of writing an email to their campus administration containing a one-page proposal for improving on-campus dining options. The proposal required 5 components (in the margin Proposal Task) to encourage deliberation. Users were instructed to have their final proposal contained on the first page of the Doc or in the top level Wikum+ summaries. At the end of the synchronous session, each group's goal was to get through as many components as possible. Then, in the following three days of asynchronous work, the groups finished up the proposal.

I conducted post-study interviews after both portions, asking users about the collaboration quality and use of their tools. I conducted iterative open coding of the interviews to achieve the 8 codes defined in Table 1, using grounded theory qualitative techniques. I then counted their frequency during the interviews, tallied in Table 3 and 4. Users also filled out a post-study survey, with Likert questions from 1–7. Metrics with average differences of at least 1 are shown in Table 2.

Results

Figure 3 shows how the two groups worked over time. The Wikum+ users started by discussing in a non-linear manner, jumping between existing comment threads and starting new threads. During the synchronous portion, they formed small summaries for stagnant threads as early as 2 and 6 minutes in. As summaries formed and collapsed nested comments, the number of words shown by default decreased (Figure 3). Users also used tags (Figure 2) to

Code	Definition
Independent	Independent writing; division of roles
Chaotic	Feelings of confusion or disorganization
Inclusive	Comments addressed; proposal content inclusive of ideas
Comprehensive	Covers significant content; detailed
Organized	Structured proposal-making process
Clear State	Can determine new or unaddressed content
New Content	Added new content to discussion
Avoidance	Avoid editing others' work

Table 1: Interview Code Definitions for Open Coding in Tables 3 and 4

	W	C
Inclusivity	5.5	4.5
Effort	3.2	4.8
Comprehensive	3.2	5.2

Table 2: Post-study survey metrics with average score differences ≥ 1 . The Wikum+ group (W) felt a greater sense of inclusion and required less effort, but the control (C) felt that they were more comprehensive.

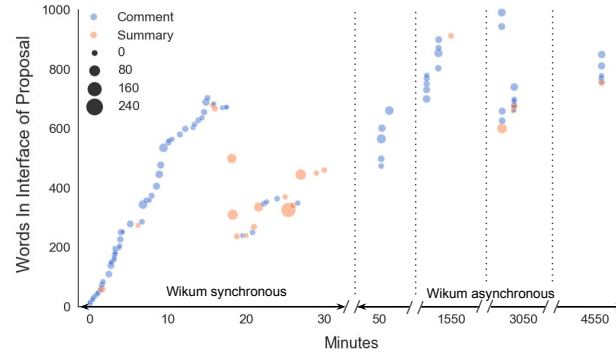
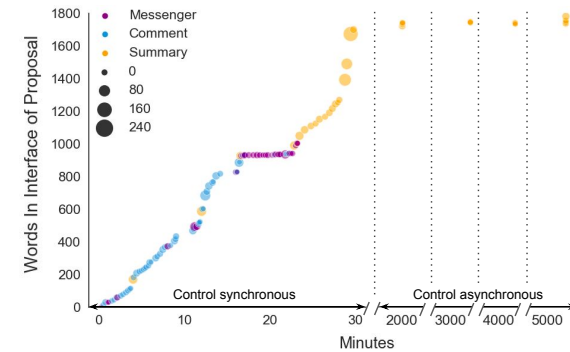


Figure 3: Plot of user activity in the two conditions over time. Each node is a user's comment or edit to a summary/proposal, with the size equal to the number of words. In the Wikum+ group, I distinguish between comments and summaries, while in the control, users had discussions both in Google Docs and Messenger, while wrote up their proposal in Google Docs. For the y-axis, I count the number of words present in the default Wikum+ view, including all top-level summaries and unsummarized comments (with summarized comments collapsed), while in the control, I count the number of words in the Google Doc. Dotted lines indicate a break in time where there was no activity.

group ideas that helped when skimming the page. With Wikum+'s recursive summary structure, users combined several sub-summaries together to form the final proposal by the end of the 30 minutes, though they had not yet completed 2 task items. During the asynchronous portion, Wikum+ users added new threads on the remaining points, growing the default number of words shown, and eventually summarized them and incorporated them into the top-level summary, thus shrinking the default number of words shown. Users also flagged summaries as incomplete to point others to work on them. In general, users kept their summaries brief and made use of bullet points in the final proposal. As seen in Figure 3, the Wikum+ final summary ended up being about 1000 words shorter than the control.

In the control condition, users discussed in a linear fashion, largely staying on a particular topic and conversing in the Google Doc. A user explained that “*having two platforms dilutes information*,” so the group used the Google Doc for discussion and Messenger for meta decisions (such as pac-



ing) or moderation. During the synchronous portion, the control group, like the Wikum+ group, did not have time to discuss the last 2-3 task items. However, at the 16 minute mark, the group hopped to Messenger to decide on a +1 voting mechanism to determine which discussion ideas to include into the proposal. The users divided up the five task items, each claiming one, and independently wrote a paragraph each. Unlike the Wikum+ group, the control group wrote up the remaining task items without discussing first. By the end of the 30 minutes, all 6 users reported that they had not read the entire proposal. During the asynchronous portion, all members of the control group were unclear where changes in the proposal had been made since the synchronous portion. Users had no further discussion and avoided editing others' work, focusing on clarifying existing ideas or fixing grammatical errors.

Users of Wikum+ felt that the process was more inclusive. From the surveys and interviews, Wikum+ users reported feeling a greater sense of inclusion when reaching

	W	C
Independent	1	5
Chaotic	6	6
Inclusive	5	1
Comprehensive	3	5
Organized	4	0

Table 3: Open coding results from interviews after the synchronous portion.

	W	C
Clear State	6	0
New Content	6	0
Avoidance	1	3

Table 4: Open coding results from interviews after the asynchronous portion.

a consensus on which ideas to include (*Inclusivity* in Table 2–Wikum+: 5.5, Control: 4.5; *Inclusive* code in Table 2–Wikum+: 5, Control: 1). Unlike the control group, Wikum+ users did not write ideas in the final proposal without first collectively discussing (*Independent* code–Wikum+: 1, Control: 5), allowing for greater collective ownership of the summaries and final proposal. This led Wikum+ users to feel that “*the summaries were very collaborative*,” so that they were “*comfortable changing the proposal because it wasn’t just [their own] ideas*.” In contrast, the +1 voting mechanism of the control left some users feeling as though their ideas were unaddressed or left out.

In addition, due to the control group’s decision to divvy up task items and work independently, users did not feel comfortable discussing or editing other users’ sections once they had been written. In the end, over 53.3%, consisting of the last 2 bullet points, of their proposal was written up without any discussion of the contents.

Wikum+ allowed for more light-weight coordination and reduced user effort. One potential reason for higher levels of inclusion is the ability in Wikum+ to coordinate work in a light-weight way. Wikum+ users explained that it was easy to pinpoint unresolved, unsummarized blue comments or flagged summaries, encouraging them to go in and summarize or edit summaries without having to ask anyone explicit permission. The half-blue/half-orange summary nodes also helped Wikum+ users see when new or unresolved comments appeared (*Clear State* code–Wikum+: 6, Control: 0). In contrast, in the control condition, users described having trouble knowing what had been done and what still needed work. This resulted in much less activity during the asynchronous portion when coordination is harder.

Another benefit of self-organization is that it makes the synthesis process easier. By summarizing early on and

throughout the process, the Wikum+ group felt more organized (*Organized* code–Wikum+: 4, Control: 0), despite the matching levels of chaos initially (Table 3). As a result, it reduced the Wikum+ group’s overall efforts when it came time to write a final proposal based on all the discussion (*Effort*–Wikum+: 3.2, Control: 4.8 in Table 2). However, it is possible this also resulted in a reduced level of comprehensiveness (*Comprehensiveness* – Wikum+: 3.2, Control: 5.2 in Table 2) in the final proposal. As Wikum+ users started to summarize ideas early in the process, this may have cut down on the time spent ideating.

Wikum+ allowed for iterative improvements and incorporation of new ideas. Another potential reason for higher levels of inclusion is the support in Wikum+ for multiple rounds of discussion and summarization. In the asynchronous portion, though both groups started with a draft proposal, the Wikum+ users added new ideas and discussion that were then incorporated into the proposal (*New Content* code–Wikum+: 6, Control: 0). In contrast, the control group had only one round of discussion and summarization. Once the initial draft was created, users avoided making any large changes in the Doc (*Avoidance* code–Wikum+: 1, Control: 3) or starting new discussion. This may be because Wikum+ users were used to mixing discussion and summarization from early on, while the control users felt they had graduated to the “writing” phase of the collaboration.

Design Implications and Future Work

Results from the pilot study suggest that the design of Wikum+ helps promote inclusiveness and self-organization compared to a control, with differences magnified in asynchronous settings. Features like flags, tags (Figure 2), and blue markers of new/un-summarized versus old/summarized content are helpful for lightweight coordination and making sense of messy threads. The pilot also showed that

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Wikum+ users could interweave discussion and summarization of different strands of ideas, suggesting that mandating designated discussion and summarization modes or only having one round of each may be limiting. However, Wikum+ could require an extended initial ideation step before permitting any summarization to encourage a sufficient quantity of initial ideas without prematurely converging. I plan to conduct larger user studies to explore these designs further.

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