Towards supporting Phases in Collaborative Writing Processes

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Abstract. This paper reports on an exploratory pilot study that has been conducted to investigate which collaboration technologies are suitable (and which are not) to support collaborative writing. The study confirmed known requirements covered by existing tools, but also revealed some requirements that are not met by available technologies.

Keywords: Collaborative Writing, CSCW

1 Introduction

Collaborative writing has been studied extensively since the 90s. Research was conducted mainly in the scientific field, since collaboration is quite common in writing papers for journals or conferences (e.g. [1]). There was also some research in the educational area. Results included that texts worked on by more than one student are of higher qualities than texts exclusively written by one student [2]. The degree of collaboration in writing tasks varies significantly between different groups. Some groups tend to only use second opinions for review or correction stages of their work, while others divide the workload between members or even work together on the same texts ([2], [3]). For some time now, research has been conducted to design tools to improve the collaboration between writers (e.g. [4]). Different tools for different aspects of a larger writing process (e.g., planning, actual writing, review) have been developed, but they often only cover one aspect of the cooperation. Quilt for example did not include any communication options [5]. Other tools like EditGrid and Writeboard do not allow the export of the resulting texts. Both older and more recent empirical studies suggest that these (often specialized) tools are rarely used in practice ([6], [7]). The reasons for this are manifold and include the users' unwillingness to learn to use new tools (even though they might benefit from them), since their subjective feeling is that a combination of common and simple software like their favorite word processor and Email already fulfills most of their needs.
Yet, technology advances at a rapid pace. New approaches for supporting collaboration (like Voice over IP or Instant Messaging) are emerging and have become commonplace in today's private and professional environments. As a result,

today's users are different from those ten years ago. They are more familiar with many kinds of collaborative technologies and often have experience in web based cooperation that might have an impact on the way that collaborative writing software should be designed. In this paper, we therefore take a fresh look at the behavior of today's users who write together in groups, on the requirements this implies for modern collaboration technology, and how these requirements can be met by currently available technology (if at all).

2 Design of the pilot study

To gain information on the needs of collaborative writing, an exploratory pilot study was conducted. The study was mainly intended to investigate coordination and communication patterns, work behavior and social behavior.

The setting was designed so that participants needed to collaborate. In the study, groups consisting of four university students were asked to write six fictional short stories (with a length of at least 900 words) about a given topic within a time limit of four hours. Each of the six stories was supposed to be written from one of six pre-defined perspectives, and the stories were supposed to be interwoven and to take place at the same time. One session topic was "an afternoon at the soccer stadium". The roles/perspectives included a player, the opposing team's coach, a reporter and others. The second topic was "movie award celebration", including the roles of an actress, a personal assistant and technical crew person (and three more).

The groups were told that their stories have to meet quality requirements in terms of spelling, writing style and consistency between stories. As such, the students were required to cooperate and communicate in order to connect their stories and to divide the work (a strict 1-to-1 relation between students and stories was not possible, since there were two more stories to write than group members). For the study, two conditions were prepared: a co-located setup and a remote setup

The *co-located* condition made use of the following technologies: In one room, six computers were placed. Each computer ran one version of the open source program Terpword. This tool offers all standard editing tools of a word processor including a word count. One feature missing is the option of a spell checker. This was intentionally not included in this version to increase the need for manual revisions and participants helping each other. Each computer allowed editing one of the six texts (i.e., students had to walk around if they wanted to see or edit multiple texts). The setup allowed to see if people work together at the same computer and allowed to easily relate locations to stories. Each user had to log into a computer before he had access to the text. If a user was idle for a longer time, the system automatically logged him out. Besides the word processor, no other software was directly offered. The room included a white board and the participants had the option of using paper if needed and were free to communicate and walk around as they wanted.

The *remote* condition included a similar version of Terpword. Here the users (sitting in different rooms) had more options than just saving the current text. They were allowed to switch between the six different texts as long as no one else was

using the desired text at that time (if that was the case, a message told them who was blocking it). For communication, a conference call with Skype was generated. The other communication options of Skype were not discouraged.

The study was conducted using two groups of 4 students each. The students came from different backgrounds and no member knew any other group member before the study. In the two days of the study, each group had to work in both conditions. One group started with the remote setting, while the other group started with the local setting.

In the co-located condition, groups were filmed during their work to be able to analyze the social interaction and the "real-world" coordination. The audio conference of the remote group was taped for the same reasons, and all remote users' screens were captured. Also, the text in the editors was saved, including information about the time of saving and the current user working on it. These files and the server log file allowed the analysis of when a remote user was accessing a text and how much of each text was written by each user. This was designed to see possible patterns in the productivity of the group. Productivity is hard to measure, but word count and the time needed are indicators of a person's and group's productivity. After the study, semi-structured interviews were conducted with the students, asking them individually about their impressions of the work done, their perceived group performance in the different settings, and about their suggestions for improving group coordination and performance. The students were also asked about the tools and their perceived usefulness to support the group. After the study, two teachers individually graded the student's texts for errors, logical inconsistencies and general writing quality and provided a ranking of the groups.

3 Results of the study

A main finding of the study is that, irrespective of the condition (remote vs. local), there are different phases of work in this kind of collaboration: A **coordination and discussion** phase, a **writing** phase, and a **correction** phase. In the first phase, one feature used by one group is the chat of Skype. They used it as a whiteboard where they posted a general outline of the "soccer-game story plot" before starting to write the individual stories. In the interview, they stated that this strategy reduced their need of paper to keep information while keeping everyone on the same level. The first phase ended with the beginning of the active story writing by the participants. This phase had a clear ending and lasted for about 20-25 minutes in all 4 settings (as observed in the screen-captured and local videos). The ending time of the writing phase varied between group members. Once a writer finished his part of the stories, he started to review any finished stories for spelling errors and inconsistencies.

The different conditions of the study did not lead to different results in terms of text quality. While group 2 was better than group 1, the ratings given by the teachers (who agreed with each other) did not show a difference between conditions: the story collections written in the remote condition were as good as the ones written in the co-

located setting. All four sets of stories (two by each group) were well written, and overall the stories contained in each set were well aligned and interwoven.

Table 1**.** Overall ranking of the group assignments

	remote (grader 1/grader 2)	**co-located(grader 1/grader 2)**
Team 1	3 / 3	3 / 4
Team 2	1 / 2	2 / 1

Studies in the past have shown that usually, remote learning and working is not as good as meeting face to face. One reason for this is that social factors, like trust, are more difficult to develop in remote collaboration [13]. Our (albeit small-scale) study confirms these problems, but also indicates that the remote setting had certain advantages. Comparing the results of the remote work with the results of the local writing, both groups had a larger rate of errors per words written when they were working locally (p=.58) and also had more inconsistencies between the stories in this setting.

Table 2**.** Error quotient (errors/words*100)

	remote	**co-located**
Team 1	1.5	2.0
Team 2	0.9	2.0

Table 3**.** Inconsistencies

	remote	**co-located**
Team 1	0	2
Team 2	1	5

This indicates a more thorough reviewing process in the remote condition. An analysis of the video logs confirms this: participants of team 2 were more willing to press a button to switch between texts than to actually get up and move to a different computer. This behavior had an impact on the consistency of the stories. While the local groups stated that they had more discussions concerning the stories and how they might be interwoven, they also produced more inconsistencies between the stories (but not more "connected" stories). Inconsistencies could be different times for events. E.g. one group had different times for a goal in the soccer scenario. One participant mentioned in the interviews that he would have also liked an option to place different texts next to each other to easier spot inconsistencies.

One student attitude that could be observed through all the groups is that the students normally wrote one or more stories alone (i.e., real collaboration in the actual writing/typing of a story was rare). Looking at the logs of each text and the amount of words changed from each user, each text has most words written by one user. With one exception, more than 95% of the texts were written by one user. Other users did minor spelling, grammar and consistency changes frequently, but these resulted in word total changes in the area of less than 10 words added/removed. There was only one exception to this: in one case a story was written to $3/4^{th}$ by one writer, while another writer expanded on this story 15 minutes later. The first writer was out of

ideas and reading another story. A second student read it for correction and included some of his ideas to reach the word limit. This was done in a remote setting.

One interesting result was that in the co-located setting no two participants were working together at the same text at the same time. The only exception was during the correction phase, where two people checked the text of a third person.

4 Requirements for a collaborative writing tool

The different phases spawned different requirements for supporting collaboration. All groups used some kind of help tools for their plot outlines in the *discussion and coordination phase*. This was physical paper in the local groups, where each participant wrote the important information down. Paper did not easily allow all the participants to share their notes and keep a general consistency without investing a lot of time and effort. In the remote setting, the outline was discussed by one group using the Instant Messenger. Here, the outline was written by one writer and each participant had the text visible all of the time. They could also add new information and send it around for all to see. But this way of information sharing was unstructured and did not allow editing existing texts, only to write new texts. All this shows clearly that some kind of plot organizer is an important element for a collaborative story writing tool. Even though no such tool was available in our study, the students creatively used other available devices to make up for this lack - a more advanced plot organizer might have lead to even better and more connected stories.

Another aspect which users found helpful with the meeting in one room was the feeling that they were able to talk more freely and easily. In the interview one student stated, that this helped them to get to know each other, resulting in off-topic communication. He stated that this increased his “group-feeling” and that he enjoyed the group work more. So a system should emulate this face-to-face feeling to allow an open and free communication. Attempts to address this challenge can also be found in recent literature [8]: Even video conferencing does not completely emulate face-to-face meetings [9], and attempts to reduce this problem [10] are not integrated in current environments.

Yet, designing collaboration software so that it fully emulates a face-to-face situation may not be the best of all choices: Some students mentioned in the interviews that the remote setting allowed them to work more independently. One participant stated that she had a much easier time writing and also listening to the chat at the same time. Since no one saw her, she could just continue working while listening to less important parts of the conversation. When she was in the same room, it would have been “rude” to continue working while participating in the conversation. As such, a compromise between the advantages of remote work and local work seems to be a reasonable research and design goal.

Most communication during the *writing phase* can be classified as one of the three following types:

- Coordination who is blocking which text and the way to change between them (only remote setting). Awareness information and parallel access to texts would be required to reduce this need for communication.
- One person gives ideas which might be used in another ones writing (in the remote setting often done using text chat). This information should be presented via a non-invasive communication channel or with a shared notekeeping/outlining tool.
- The third part was mostly coordination of the contact points in the story. Since this requires often more than 2 people this also requires a shared outlining/notekeeping tool. For already existing texts awareness of existing parts would reduce the need for disrupting communication.

The communication focus in the *correction phase* was on the coordination of text access (in the remote setting only), and on the discussion of inconsistencies. Here, easy and fast access to all the texts is very important to allow a fast comparison of texts: The co-located groups switched between texts less often than the remote groups, even though the switching between texts often required coordination between users (see table 4).

Table 4**.** Average numbers of text changes (std. deviation)

	Remote	**co-located**
Team 1	12 (~3.39)	10
Team 2	26.3 (~4)	10

While awareness about the content of already written texts is important in the writing phase, it is even more so in the correction phase to spot inconsistencies. Awareness functions which bring more than one text to the screen of writers could help for finding inconsistencies. Also, the participants mentioned in the interviews that it would help them to see what each user is working on. This helps for asking the person who is writing about a certain character and if he already was past a certain (connection) point of stories.

5 Towards an integrated collaborative writing environment

Currently, there are no tools that satisfy all the requirements of the table below. While current tools successfully satisfy some of the requirements, they do not cover all of them (e.g. Google office does not include a communication module).

The requirements mentioned before can be categorized in three groups: *Process awareness* informing about the group actions, *product awareness* helping with the texts, and *time/effort saving* components. Since not all requirements are needed in all phases, the system should reflect the phases of the work process without the requirement of different tools needed to be open in different phases.

The different requirements for an integrated synchronous writing environment, including existing or possible solutions, are presented in table 5.

One approach for addressing many of the (primarily social) requirements in some of the work phases seems to be the use of 3D CVEs (collaborative virtual environments). While their main use is still in the area of entertainment, they have become a research

topic for CSCW and CSCL [11]. Clearly, using 3D for text editing does not seem like an obvious tool. Yet, CVEs offer a lot of awareness options like the current position of the other users and what they are working on. They also often allow for communication (e.g. VoIP and chat) increase the immersion of the users though avatar customization, and open new communication channels through the use of gestures. These options might increase the building of social bonds and therefore seem worth investigating specifically for the discussion and coordination phase.

Table 5**.** General requirements and design ideas

Category	Requirement	Existing solutions	Phase
Process awareness	Build social bonds	Advanced video conferencing; Collaborative 3d environments	Discussion and Coordination
	Allow communication	VoIP, IM, email	all
	Awareness of participants current work		Writing and correction phases
Product awareness	Show/ help design plot outline	Shared whiteboard; plot outlining tools [12]; shared notes	(Help design) discussion phase. (Show) other phases
	Allow access to text parts with same topic		Writing and correction phase
Time saving	Fast switching between texts		(mainly) correction phase

During the writing phase however, the requirements are different. Here, users should have an easy access to product awareness information but should also have a relatively undisturbed working environment which allows them to focus on their texts. Here, a 2D interface seems more appropriate. Another important aspect is to create product awareness. The group members should have an easy access to other parts of written texts and know what is going on in the text production. One option here, which we will investigate in our future research, is to create an algorithm which checks the current writing of a user against existing writing of others, and presents relevant parts of the other texts (e.g., to support users in avoiding inconsistencies).

6 Conclusion

This paper presented the results of an exploratory study for collaborative writing. The most interesting results are that a co-located and a remote setting did lead to different results in terms of the resulting product, even though the remote setting made use of

relatively “low tech” tools. Users in both settings went through the same three phases during their writing activity: a discussion phase, a writing phase and a correction phase. This paper also presents general requirements for a tool meeting the requirements of all three phases for this kind of work and discusses one possible implementation fulfilling these requirements. Future work will include an example implementation and a validation of the requirements.

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