

Collaborative Writing in the Context of Science 2.0

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ABSTRACT

The increasing number of co-authored academic papers points to the importance of collaborative writing in contemporary research. Digital technologies add a new dimension to collaborative writing by providing co-authors with access to the same document and enabling co-authors to edit the shared text at the same time. The availability of web-based tools for collaborative writing prompts the question of the extent to which researchers incorporate these tools into their scholarly practices. Based on my statistical analysis of the data from the *Science 2.0 Survey* (2014), conducted in cooperation with the Leibniz Research Alliance Science 2.0, I examine the usage of digital technologies in the process of collaborative writing among researchers in Germany. I use the concepts of asynchronous and synchronous modes of writing, derived from the field of Computer Supported Cooperative Work, to discuss collaborative writing strategies in the context of Science 2.0. My study shows that researchers use a mixture of different writing strategies and that they tend to use the same tool for different writing strategies. Moreover, I discuss researchers' attitudes towards online text editors. In reflecting on collaborative writing, I consider both the technological and social aspects.

CCS Concepts

• Human-centered computing □ Human computer interaction (HCI) • Collaborative and social computing □ Collaborative content creation. • Collaborative and social computing systems and tools □ Synchronous editors □ Asynchronous editors.

Keywords

Collaborative Writing, Writing Strategies, Co-authorship, Digital Technologies, Science 2.0, Open Science, Researchers, Asynchronous, Synchronous, Online Survey

1. INTRODUCTION

Web-based technologies open up new possibilities for knowledge creation and dissemination processes and provide researchers with the technological means to follow the idea of open science. Sharing research insights can happen on an unprecedented scale. In the words of Dame Wendy Hall: 'The Web has fundamentally changed how we do science as well as enabling scientific collaboration.' [9]. In many disciplines researchers rely on collaboration to answer complex questions [4] and an increasing

number of academic papers are co-authored [17]. Web-based technologies can facilitate collaborative writing. Online text editors allow several authors to access a single shared document. Moreover, when needed, co-authors can work in the same document at the same time. In this sense, integrating web-based technologies into collaborative writing practices constitutes an element of science 2.0. The question I explore in this paper is the extent to which web-based technologies are utilised by researchers in their collaborative writing practices. In order to answer this research question I examine the collaborative writing strategies researchers use and identify the digital technologies they use for them. I show that researchers use a mixture of different writing strategies and that they tend to use the same tool for different writing strategies. I briefly describe the demographics of the researchers who participated in the survey in the context of their collaborative writing practices and present researchers' attitudes towards the usage of online text editors for collaborative writing. Subsequently, I discuss my findings, taking both the technological and social aspects into consideration.

2. REVISITING COLLABORATIVE WRITING

Collaborative writing is a complex phenomenon and has been studied from various points of view, in works that often draw on its interdisciplinary nature [6,10]. Scientists have discussed the design of systems supporting collaborative writing [5,15,16], examined collaborative writing practices among academics and in industry [6], explored the possibility of employing collaborative writing for educational purposes, and studied the social dynamics between co-authors [1,2,12]. Various forms of groupware, including tools for collaborative writing, were intensively studied in the late 1980s and 1990s when they emerged as a new phenomenon [5,11,16]. Since then, some tools have disappeared, others have been refined, and new ones have emerged. As time has passed, researchers have had the chance to integrate new digital technologies into their working practices. Thus, I think it is important to revisit collaborative writing. For the purposes of my research (following [3] and [11]) I define collaborative writing as two or more people working together to produce a written document for which all co-authors feel responsible.

3. FRAMING COLLABORATIVE WRITING

Collaborative writing can be performed using different writing strategies. Drawing on my analysis of the literature on collaborative writing in general and previous categorisations of writing strategies in particular [6,10,15], I have distilled four writing strategies that capture the essence of different approaches to collaborative writing in as few categories as possible. *Writing strategy A (WS_A)* involves a single author performing the majority of the writing while the others provide feedback. In

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writing strategy B (WS_B) the text remains with one author at a time and writing happens in sequence. In **writing strategy C (WS_C)** each co-author is responsible for producing a section of the text and writing is done in parallel. **Writing strategy D (WS_D)** involves each co-author writing in the same shared document. Here, all authors have access to the most recent version of the text and can respond to what their co-authors have already written. Moreover, co-authors can work in the same document at the same time. The described writing strategies serve as a structure to broadly categorise the characteristic approaches to collaborative writing. The actual writing practices of researchers are more nuanced. In this paper, I focus on the act of collaborative writing in an academic context and the role digital technologies play in it, instead of analysing the whole collaborative writing process.

The writing strategies can be described using the notion of asynchronous and synchronous modes of working, which are derived from the field of Computer Supported Cooperative Work [11]. In general, asynchronous refers to working on something at different times, while synchronous refers to working on something at the same time. Applied to collaborative writing strategies, the **asynchronous mode** refers to co-authors working on the text at different times. Accordingly, WS_A, WS_B, and WS_C, can all be classified as asynchronous modes of writing. Asynchronous writing is typically done in separate documents rather than in a shared online document. Thus, access to the most recent version of the text is often mediated via a digital technology, for example a Word document in combination with email or content sharing services. The **synchronous mode** refers to co-authors working on the text at the same time. In this sense, WS_D qualifies as synchronous because it provides all co-authors with access to the most recent version of the text and additionally includes the technical possibility of several co-authors working on a shared text simultaneously. All the described writing strategies can be performed using pen and paper, an offline word processor or an online text editor. While using a combination of different digital technologies for asynchronous modes of writing appears to be common practice among researchers, this approach to collaborative writing requires increasing coordination efforts as the number of co-authors grows. Thus, especially for synchronous writing modes, online text editors can be relevant as they can potentially improve the collaborative writing process, particularly with reference to collaborations across distances. From the technological perspective, online text editors provide co-authors with access to the most recent version of the shared text. Moreover, online text editors enable several co-authors to work on the same document, and they can even work on it concurrently. In this sense, digital technologies bring a new dimension to collaborative writing as they make it possible to apply working processes that were not feasible before.

4. SURVEYING THE ACADEMIC LANDSCAPE IN GERMANY

The empirical basis of my analysis is the online *Science 2.0 Survey 2014* [14, see also 13], which was conducted as part of the Leibniz Research Alliance Science 2.0. The questionnaire was divided into a general part that addresses communication forms and the use of online tools in academia ($N \approx 2,000$) and an optional part consisting of my questions regarding the use of digital technologies for collaborative writing ($N \approx 1,300$). The questionnaire items relevant for this analysis referred to the usage of digital tools for collaborative writing purposes, the percentage of writing performed in collaboration, a series of statements

measuring attitudes towards digital technologies for collaborative writing, and the usage of digital technologies for the described writing strategies. The questionnaire was available in both German and English. The sample includes researchers from across different disciplines, from universities as well as from research institutes, thus providing a good coverage of the German academic landscape. The results presented are based on my analysis of the data concerning the usage of digital technologies for collaborative writing and complemented by demographic data from the main part of the survey. The statistical analysis was performed using IBM Statistics SPSS 22.

5. COLLABORATIVE WRITING AND THE USAGE OF DIGITAL TECHNOLOGIES

My analysis of the data from the *Science 2.0 Survey* shows that over half of the researchers write between 60% and 100% of their academic papers in collaboration. In the following sections, I derive combinations of collaborative writing strategies used by researchers in the sample and show that researchers tend to use a mixture of different writing strategies. I describe which digital technologies researchers use most frequently for the previously described writing strategies, showing that researchers tend to use the same tool across different writing strategies. Next, I provide a brief overview of the demographics of the researchers who participated in the survey and present findings concerning the researchers' attitudes towards the usage of online text editors for collaborative writing.

5.1 The Writing Strategies

Collaborative writing can be performed using various writing strategies and each strategy has its advantages and disadvantages. In order to find out which writing strategies are used by the researchers in the sample, I calculated the frequency of usage for each strategy as well as for various combinations of these strategies. The frequency is based on the survey data capturing the usage of digital technologies for the writing strategies. The analysis clearly shows that the researchers in the sample use a mixture of different writing strategies. Over half of the surveyed researchers (56%) use one of the asynchronous writing strategies (WS_A or WS_B or WS_C) and the synchronous writing strategy (WS_D). However, 38% of the researchers use one of the three asynchronous writing strategies but not the synchronous one. Interestingly, apart from the 3% of researchers who use only WS_A, there are practically no researchers in the sample who use just one writing strategy.

5.2 The Tools

The most frequently used tool for all writing strategies is Word (WS_A 74%, WS_B 69%, WS_C 64%, WS_D 24%). For collaborative writing purposes, Word is used in combination with other digital technologies such as email and content sharing services. There is a positive correlation between the usage of Word and email for each of the writing strategies (Pearson correlation coefficients for WS_A: $p=0.163$, WS_B: $p=0.209$, WS_C: $p=0.264$, WS_D: $p=0.393$; the correlations are significant at the 0,01 level). Similarly, there is a positive correlation between the usage of Word and content sharing services for each of the writing strategies (Pearson correlation coefficients for WS_A: $p=0.129$, WS_B: $p=0.165$, WS_C: $p=0.162$, WS_D: $p=0.243$; the correlations are significant at the 0,01 level). Also, 43% of researchers use both Word and content sharing services for collaboration (Pearson-Chi-Square test $\chi^2 = 12.498$, the result is significant). Since Word as such has no integrated functionality that allows for simultaneous writing, it is likely that respondents

assumed that using Word in combination with other tools classifies as synchronous writing. Alternatively, it is also possible that some researchers use versions of Word that have integrated capabilities for synchronous access to and editing of the document, such as Microsoft 365 Office. This differentiation, however, cannot be made based on the available data. Despite its focus on facilitating synchronous modes of writing, the usage of Google Docs across writing strategies only reflects this to some extent (WS_A 11%, WS_B 7%, WS_C 12%, WS_D 18%). Nevertheless, Google Docs is the second most frequently used text editor for WS_D.

5.3 The Researchers

The researchers in the sample represent a relatively good coverage of the German academic landscape. A large proportion of researchers are between 25 and 35 years of age (49%). Correspondingly, many of them are at a relatively early stage of their academic career (doctoral students and scientific staff make up 66% of the sample), although 14% of the individuals in the sample are professors and junior professors. In terms of academic discipline, the largest proportion of the respondents (43%) works in the field of mathematics, the natural sciences, and computer science. Nevertheless, the linguistic- and cultural sciences (18%) as well as law, economics, the social sciences (16%) and engineering (15%) are also well represented. Overall, researchers from mathematics, computer science and the natural sciences as well as engineering do most collaborative writing. In terms of academic position, the researchers who do most collaborative writing are postdocs, doctoral candidates and research assistants. Among the researchers surveyed, 45% are female and 55% are male.

5.4 Attitudes towards Collaborative Writing

Collaborative writing is a complex task. The effectiveness of writing with co-authors can be supported by appropriate technology. The perceived benefit of a technology determines its adoption, and the mere availability of a tool does not mean that it will be used. Since the attitude towards a technology sheds additional light on its usage, I surveyed researchers on their opinions concerning the role of digital technologies in the process of collaborative writing. Generally, researchers have a positive attitude towards digital technologies (there is a positive correlation between an index covering all digital technologies for collaborative writing from the survey and an index capturing the researchers' attitudes towards digital technologies; Pearson correlation coefficient $p=0.272$, the correlation is significant at the 0.01 level). According to the data, 27% of researchers claim that online word processors increase the productivity of collaborative writing (24% disagree with this statement). At the same time, 33% state that online word processors do not offer the functionality researchers need for the collaborative writing of academic papers (18% disagree). Additionally, 41% of respondents do not feel that using online word processors is complicated (only 15% find it complicated). Furthermore, 40% of researchers do not have enough trust in cloud-based technologies in order to use them for collaborative writing (30% have enough trust). These statements suggest that even though online text editors carry the promise of supporting the collaborative writing process and despite researchers' generally positive attitude towards online text editors, the lack of adequate functionality in an academic context and the lack of trust in cloud-based technologies might have an impact on the adoption of online text editors by researchers.

6. DISCUSSING COLLABORATIVE WRITING

In discussing the presented findings on collaborative writing in the context of science 2.0, I consider both the technological and social aspects. The fact that researchers use a mixture of different strategies for collaborative writing highlights that each approach has its advantages and disadvantages, which in turn depend on the phase of the writing process. Asynchronous modes of working on the text seem more relevant when each individual co-author is writing their contribution to the joint text. Synchronous modes of working might be more relevant towards the beginning and towards the end of the writing process, when major decisions are taken. While using a mixture of different writing strategies, my analysis also indicates – in line with previous studies [12,15] – that despite the technological possibilities, researchers exhibit no need to write simultaneously. Having access to the most recent version of the text is crucial and digital technologies can support this in various forms. Co-authors can send their contributions via email, make them available via content sharing services or share them in an online text document. Writing in the same document at the same time, however, appears not to be relevant to most researchers. Coordinating the schedules of several researchers to find the time for simultaneous writing involves extra effort. Furthermore, the awareness of another person concurrently working in the same document can prove to be distracting for some authors. Researchers may feel uncomfortable with writing online and automatically sharing their raw text with their co-authors [12]. They might prefer writing strategies that allow them to maintain greater control over their own contribution to the shared text. Regardless of the common writing strategy, each author brings her or his individual ways of working to a joint research project. Writing in the same version of a shared document, for instance, can affect the social relations between co-authors. Granting other co-authors access to work-in-progress requires mutual trust as it can expose vulnerabilities. Birnholz et al. suggest that 'edits and comments often carry social meaning. They may be interpreted as harsh criticism or threats to autonomy, and can have emotional and relational impact.' [1] Thus, it is possible that because using Word in combination with other digital technologies gives researchers control over which version of the text to share at what point in time, it is another reason why researchers prefer to use Word over online text editors. Choosing the tools for collaborative writing has not only technological but also cultural and social aspects. As Cerrato points out 'There is a culture to write together that depend on people, on tasks and on tools.' [5]. Taking disciplinary differences into account, online text editors do not seem to cater to the needs of academic writing. As described in the results, a third of the surveyed researchers think that online word processors do not offer the functionality they need for the collaborative writing of academic papers. Thinking further, online text editors could additionally better support the process of collaborative writing by applying artificial intelligence methods to collaborative writing technologies in order to improve the collaborative writing process [8].

7. CONCLUSION

On the basis of data from the *Science 2.0 Survey*, this paper shows that researchers use a mixture of writing strategies when collaboratively writing academic papers and that they tend to use the same tool across asynchronous and synchronous modes of writing. I have considered both technological and social aspects in reflecting on collaborative writing practices. Possible reasons for researchers' preference for using Word in combination with other

digital technologies rather than online text editors might be the lack of trust in cloud based technologies, no perceived added value of online text editors due to inadequate functionalities for academic writing and a general tendency to stick with familiar tools and writing patterns. Additionally, some researchers might feel uncomfortable with sharing their raw text fragments with co-authors as this can lead to misunderstandings. Sharing research insights in a suitable way is an important aspect of collaborative writing and also of open science in general. In conclusion, I want to stress the importance of digital technologies supporting various forms of collaborations and providing such technological solutions that allow researchers to be in control of their work.

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