

A Table for Four: Collaborative Writing in Shared Cloud Documents

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Abstract

Research on collaborative writing (CW) in shared cloud documents is deeply rooted in the sociocultural theory, focusing on the role of peers in learning. Whereas insights have been obtained on collaborative writing mechanisms, phases of co-construction of knowledge (CCK) have not been studied in the same intensity. This study sought to investigate episodes of online simultaneous collaborative writing (SCW) of 48 science and engineering education students divided into 12 small groups. Cloud applications functioned both as CW platforms and as research tools, using the revision history pane for data collection. Guided by the multiple-case theory-building method, this study included also semi-structured interviews and classroom observations. Content analysis of 997 document versions indicated three modes of online SCW on a range of high, medium, and low levels. Most of the written episodes were written in-class, parallel in nature, indicating a low SCW level. Alongside, a positive relationship was found between SCW and CCK as higher modes of SCW facilitated higher phases of CCK. Our study showed that the capabilities of cloud shared documents were not fully utilized since students still adhere to familiar learning habits.

Keywords: co-construction of knowledge, simultaneous collaborative-writing, shared cloud documents, sociocultural theory, small groups.

Literature Review

The present study is guided by the sociocultural theory that emphasizes the role of social interactions, discourse, and knowledge sharing as essential for learning and cognitive development (Lave & Wenger, 1991; Vygotsky, 1978). This theory maintains that interactions among learners facilitate cognitive development and the construction of knowledge (Palincsar, 1998). Interactions among learners and shared thinking functions are viewed as collaboration (Rogoff, 1998), which is addressed in collaborative writing both as a group's product and its means for communication (Cerrato, 2003).

Collaborative writing (CW) is conceptualized as "an iterative and social process that involves a team focused on a common objective that negotiates, coordinates, and communicates during the creation of a common document" (Lowry, Curtis, & Lowry, 2004, p. 70). CW can be enhanced by technologies that allow real-time sharing and simultaneous authoring. Cloud applications, such as Google docs, facilitate simultaneous CW (SCW) in an evolving online document. These documents include a revision history pane that records, saves, and displays the changes performed by each member of the group; thus, functioning as a writing platform as well as a research tool. In this study, the digital revision history pane was harnessed to facilitate a better understanding of the online SCW. Our working hypothesis was that the document construction process reflects upon the way group members collaborate with each other and co-construct knowledge.

In their research on co-construction of knowledge (CCK), Gunawardena, Lowe, and Anderson (1997) identified five sequential phases in asynchronous CW in online forums. The authors

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maintained that these phases occurred during online written debate and thus characterize the social construction of knowledge in a constructivist learning environment. Our study examined these five phases in the context of online SCW in shared cloud documents.

Research Goals and Participants

As previous research on CCK has focused on asynchronous CW (Onrubia & Engel, 2009), its advent in simultaneous collaborative writing (SCW) is yet to be studied. In light of the aforesaid, our objectives were to characterize SCW modes in online writing processes and to understand the way knowledge is co-constructed in these modes.

The study included 48 science, technology, engineering, and mathematics (STEM) education students that participated in a science and technology teaching methods course. The participants were divided into 12 small learning groups of 4 students and met weekly in-class throughout a 14 week semester. The course objectives were to acquaint STEM education students with the content and pedagogy of teaching Science and Technology for middle school while integrating advanced technologies. The course applied the cloud pedagogy framework, emphasizing studio-based instruction – a combination of short lectures with long hands-on active learning sessions (Barak, Harward, & Lerman, 2007; Barak & Levenberg, 2014).

The course required a collaborative production of a digital binder in the form of a Google Documents in a folder withholding a collection of collaborative outcomes. The students were instructed to collaboratively write a literature review; construct a glossary of terms; plan a scientific experiment; design an instructional game; and write a reflection. The in-class learning setting was flexible and dynamic; students were unbound and able to work in variable working modes offline and online. They could choose to stay and work in the main classroom or any other suitable location. They could continue working in groups or decide to split the tasks and work individually. The students used their own laptops or the desktop computers available in the classrooms. The distance writing was carried out after class meetings, in the students' free time. The distance communication was aided by phone calls; mail correspondence; Skype calls; and Google Docs chats and comments.

Research Tools and Analysis

To provide an in-depth examination of the sociocultural aspects of CW, the study was guided by the multiple-case theory-building method that synthesized between Grounded Theory and multiple-case studies (Glaser & Strauss, 1967; Eisenhardt & Graebner, 2009; Yin, 2014). Following, each small group served as a separate case; and was also examined as part of a bounded system (Creswell, 2011). The research tools included Google documents, semi-structured interviews, and classroom observations, as described below:

Google documents – included 28 online documents, 12 submitted papers and 16 drafts. In the document versions, differentiating colors visualized users' revisions and revealed writing modes in SCW. The revisions (n = 997) were screen-captured and examined. The SCW episodes of each group were singled out to a summarizing document and analyzed for modes of SCW and similar attributes. Additionally, every episode was also analyzed regarding CCK phases adapted from Gunawardena et al. (1997): (I) sharing of information; (II) discovery of dissonance; (III) negotiation of meaning; (IV) modification of proposed synthesis; (V) application of newly constructed meaning. The phases were placed in group matrixes and eventually collected and summed in one inclusive matrix to view the whole picture.

Semi-structured interviews – eighteen interviews of 30-to-60 minutes, were administered during and after the semester. The interviews were audio-taped, transcribed, and analyzed to affirm the findings of SCW modes and CCK phases. Interview questions included the following: 1. *did you participate in any simultaneous (at once) writing process in class or from distance? Describe the experience.* 2. *In what ways did SCW contribute to knowledge construction (individually and as a group)?*

Classroom observations – the researchers conducted participant observation during the active learning sessions. The observations assisted in examining the in-class discourse while the students were engaged in writing the digital binder, using Google documents. The observations were recorded in a researcher's log. This provided the ability to evaluate modes of in-class SCW. As for reliability control, inter-judge consensus of two independent judges was used to corroborate, triangulate, and verify the corpus of data and the findings. The anonymity of the participants was maintained by using pseudonyms.

Findings

Out of the 997 document versions analyzed, only 66 episodes of SCW were identified (7%). In the remaining 93% of the writing episodes, students made individual contributions to the evolving shared document. Despite a relatively low number of SCW episodes, a three level taxonomy of SCW modes emerged, as follows:

- *Parallel SCW* – two or more collaborators write simultaneously on the shared document on unrelated topics, tasks, etc., indicating a low level of SCW (56%).
- *Integrated SCW* – two or more collaborators write simultaneously on the shared document, but not on the same paragraph; their writing is related in topic, task, etc., indicating a medium level of SCW (21%).
- *Interwoven SCW* – two or more collaborators write simultaneously on the shared document and in the same paragraph; their writing is related in topic, task, etc., indicating a high level of SCW (23%).

The phases of CCK that occurred in the course of SCW indicated that within the 66 SCW episodes, the lowest phase CCK – sharing of information was prominent (72%). The succeeding phases – discovery of dissonance (5%); negotiation of meaning (5%); modification of proposed synthesis (8%); application of newly constructed meaning (10%) were scarcely expressed in the written episodes. The combination of the three levels of SCW and the five phases of CCK comprised a matrix of 15 possibilities (Table 1). Only nine of these combinations were found in the documents and three examples are hereby presented:

1. A *parallel SCW* episode associated with the sharing of information phase shows that in the process of SCW, while one student was editing a subtopic of energy, another student was writing about a different subtopic in another page. This represents a low phase of sharing of information in writing on the same document but it does not present any simultaneous interaction between writers. For example, Orly is deleting some information about velocity while Rony is writing about thermal gliding (Group 5, December, 2013).
2. An *Integrated SCW* episode related to the sharing of information phase, indicated two writers relating to the same task, but not in the same paragraph. They obviously see each other's' writing while sharing of information. For example: Ya'ara is writing the title of a new paragraph while Hussain is writing a number of definitions of energy under the same title and the same task (Group 2, November, 2013).
3. An *Interwoven SCW* episode linked to the dissonance and inconsistency phase, demonstrates writing together on the same paragraph and task, while displaying a disagreement between writers. For example: Sara and Dan are jointly writing the rules of a learning game on 'wind energy', correcting a mistake that was jointly written on the same paragraph (Group 1, December, 2013).

The CCK phases and their distribution within the SCW modes are presented in Table 1, on a range of (I) Lower CCK phase to (V) higher phase.

Table 1. CCK phases and their distribution within the SCW modes (N = 66)

Phases of co-construction of knowledge SCW episodes on shared documents	(I) Sharing of information	(II) Discovery of dissonance	(III) Negotiation of meaning	(IV) Modification of proposed synthesis	(V) Application of newly constructed meaning
No. of parallel SCW	37	0	0	0	0
No. of integrated SCW	10	1	1	2	0
No. of interwoven SCW	1	2	2	3	7
Total	48	3	3	5	7

Table 1 indicates that most of the SCW episodes were in the low phase of sharing of information (n=48). In the *parallel* episodes of SCW, only the lowest phase of CCK was found. In the *integrated* SCW, most episodes indicated the lowest phase of CCK, but there were some evidence for higher phases. Contrary to this, among the *interwoven* SCW episodes, we found a gradual increase towards higher phases of co-construction of knowledge.

According to the time stamp on the Google Docs, 58 SCW episodes (88%) were conducted in class hours, during the studio sessions, while students were working individually, on separate computers. The distribution of SCW episodes, in-class (online in close proximity) vs. distance (online geographically apart) is presented in Table 2.

Table 2. Distribution of SCW episodes in in-class and distance settings

SCW episodes on shared documents	In-class SCW episodes No. (%)	Distance SCW episodes No. (%)	Total
Parallel SCW	32 (85%)	5 (15%)	37
Integrated SCW	11 (78%)	3 (22%)	14
Interwoven SCW	15 (100%)	0 (0%)	15
Total SCW episodes	58 (88%)	8 (12%)	66

Table 2 indicates that most SCW was conducted while students were in close proximity, in-class. All interwoven episodes (high-level SCW) were carried out that way. Correspondently, most distance episodes display the medium and lower level of SCW.

Discussion

Few collaborative writing (CW) episodes (7%) were written simultaneously. From these, only 12% were written in distance writing and primarily appropriated to lower levels of simultaneous collaborative writing (SCW). Although shared cloud documents enable high levels of SCW and high phases of co-construction of knowledge (CCK), most episodes indicated low phases of both constructs. The findings also showed that in the interwoven level of writing, more episodes were registered in the higher phase of CCK. Reciprocally, in the parallel mode, a reverse pattern emerged – all the episodes were in the lower phase of CCK. This may suggest that interwoven SCW facilitates higher phases of CCK and parallel SCW facilitates low CCK.

These findings can be explained by students' 'habits of mind', their inclination to adhere to familiar learning and writing habits (Barak, 2014; Spigelman, 1998; Van der Geest, 1996). Perceptions of writing as a singular process and as a product of a writer's own labor can further illuminate the obstruction of higher modes of SCW and of higher phases of CCK (Ede & Lunsford, 2001).

While online collaborative writing on the whole is relatively studied among higher education students, research of online SCW is still in its initial stages. The depicted picture allows building a preliminary framework for further research and brings new insights to research regarding SCW and specifically CCK in SCW in shared cloud documents. In the globalized reality of the 21st century, these findings may serve as a starting point to both theoretical and empirical future research of this untapped aspect of CW.

References

- Barak, M. (2014). Closing the gap between attitudes and perceptions about ICT-enhanced learning among pre-service STEM teachers. *Journal of Science Education and Technology*, 23(1), 1-14. DOI: 10.1007/s10956-013-9446-8
- Barak, M., Harward, J., & Lerman, S. (2007). Studio-based learning via wireless notebooks: A case of a Java programming course. *International Journal of Mobile Learning and Organization*, 1(1), 15-29.
- Barak, M., & Levenberg, A. (2014). Harnessing cloud applications for promoting progressive education principles among science teacher trainees. *National Association for Research in Science Teaching (NARST)*, Pittsburgh, USA, April.
- Cerrato, T. (2003). Collaborating with writing tools. An instrumental perspective on the problem of computer-supported collaborative activities. *Interacting with Computers* 15(6), 737-757. DOI 10.1007/s11218-010-9141-z
- Creswell, J. W., & Plano Clark, V. L. (2011). *Designing and conducting mixed methods research* (2th ed.). Thousand Oaks, CA: Sage.
- Ede, L. & Lunsford, A. (2001). Collaboration and Concepts of Authorship. *PMLA*, 116(2), 354-369.
- Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: opportunities and challenges. *Academy of Management Journal*, 50(1), 25-32. DOI: 10.5465/AMJ.2007.24160888
- Glaser, B., & Strauss, A. (1967). *The Discovery of Grounded Theory: Strategies of Qualitative Research*. London: Wledenfeld and Nicholson.
- Gunawardena, C. N., Lowe, C. A., & Anderson, T. (1997). Analysis of a global online debate and the development of an interaction analysis model for examining social construction of knowledge in computer conferencing. *Journal of educational computing research*, 17(4), 397-431. DOI: 10.2190/7MQV-X9UJ-C7Q3-NRAG
- Lave, J., & Wenger, E. (1991). *Situated Learning: Legitimate Peripheral Participation*. NY: Cambridge University Press.
- Lowry, P. B., Curtis, A., & Lowry, M. R. (2004). Building a taxonomy and nomenclature of collaborative writing to improve interdisciplinary research and practice. *Journal of Business Communication*, 41(1), 66-99. DOI: 10.1177/0021943603259363
- Onrubia, J., & Engel, A. (2009). Strategies for collaborative writing and phases of knowledge construction in CSCL environments. *Computers & Education*, 53(4), 1256-1265. DOI: 10.1016/j.compedu.2009.06.008
- Palincsar, A. S. (1998). Social constructivist perspectives on teaching and learning, *Annual Review of Psychology*, 49, 345-375. DOI: 10.1146/annurev.psych.49.1.345

- Rogoff, B. (1998). Cognition as a collaborative process. In D. Kuhn, R. S. Siegler, & W. Damon (Eds.), *Cognition, perception, and language: Vol. 2. Handbook of child psychology* (5th ed.) (pp. 679–744). New York: Wiley.
- Spigelman, C. (1998). Habits of mind: Historical configurations of textual ownership in peer writing groups. *College Composition and Communication*, 49(2) 234-255.
- Van der Geest, T. (1996). Studying "real life" writing processes: A proposal and an example. In: C.M. Levy & S. Ransdell (Eds.). *The Science of Writing: Theories, Methods, Individual Differences and Applications* (pp. 149-161). Mahwah, NJ: Lawrence Erlbaum Associates.
- Vygotsky, L. S. (1978). *Mind in Society: The Development of Higher Psychological Processes*. (pp. 1-153) Cambridge, MA: Harvard University Press.
- Yin, R. K. (2014). *Case study research: Design and methods*. (pp. xx-265). Los Angeles: SAGE Publications.