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Facilitating Synchronous Collaborative Writing with a Collaboration Script

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Abstract

A significant part of work in industry is carried out in co-located or virtual teams. Therefore, training information systems (IS) students to collaborate both face-to-face and online is necessary. Findings from computer-supported collaborative learning (CSCL) research suggest that students need additional support to learn to collaborate effectively. Such support can be provided through collaboration scripting. In this paper, we discuss the effects of a collaboration script on the learning process in the context of an online synchronous collaborative writing task. The study employs an experimental design. The results demonstrate that scripted groups spent most effort on coordination and planning, while unscripted groups used most effort on contributing to the case solution. Closely following the collaboration script improved the quality of learners' discussions. However, the groups who chose to only partly follow the script primarily settled with quick consensus-building during the discussion phase, much the same way as unscripted groups.

Keywords: Computer-supported collaborative learning (CSCL), collaboration scripts, collaborative writing, IS education, Google Docs.

1. Introduction

Collaborative learning is becoming more wide-spread in higher education. Information Systems (IS) education is not an exception, with much emphasis on collaborative projects and teamwork. Collaborative skills are a necessary asset for IS students wanting to build a successful career in industry [1,2], [18]. Online collaboration skills are of special importance as much work is nowadays carried out in virtual teams. However, while IS research has paid much attention to the emerging information and communication technologies (ICT) in various areas, relatively little discussion has been focused around their role in IS education [13].

Good collaboration is characterized by both effective coordination of joint work (e.g., managing time and dividing the tasks) and communication (e.g., turn-taking and mutual understanding) [24]. It remains a challenge for many to be able to get in groups online and solve tasks quickly. It is common for virtual teams to be composed of members coming from diverse backgrounds and having limited shared history [25]. Therefore, virtual team members often experience problems related to time and space, for example lack of agreement upon the norms of online presence and turn-taking [26]. Coordination challenges are usual for online collaboration in general [28]. Slow start-up phases and lack of communication about time constraints are typical challenges for online teams. In addition, often teams start with the task right away, without contributing to the aspects of team development or planning [20]. Lack of shared understanding is likely to impede productive group processes [21].

Part of the IS research has focused on collaboration engineering which is aimed at facilitating teams of practitioners by providing them with specific collaboration patterns targeted at reaching the goal [32]. Collaboration engineering research has been mainly aimed at the organization context. However, teaching students about effective strategies to solve group tasks becomes a necessary objective in higher education. Recently some work has been done exploring the effects of collaboration engineering in the learning context [3,4,5].

The computer-supported collaborative learning (CSCL) field of research has demonstrated that online learning groups share much of the challenges typical for virtual teams. Moreover, students who do not have previous experience in collaboration often fail to effectively analyze their learning partners' contributions and their relation to one's own viewpoints without additional support [33]. Much discussion in CSCL research has focused on the implementation of "collaboration scripts" [7], [24], [33], that is, sets of clues aimed at helping students to both sequence their learning activities and improve their argumentation.

In this paper, we examine the effects of a jigsaw collaboration script on the quality of the collaborative learning process and student interactions in an online synchronous collaborative writing assignment. The effects are assessed using an experimental design with two control (unscripted) groups and three treatment (scripted) groups. The results demonstrate that while collaboration scripting has the potential to improve the quality of the learning process, there is a risk of increasing students' cognitive load which may lead to extra coordination efforts or a decision not to follow the script.

The paper is structured as follows. Section 2 provides relevant background on collaboration scripts research. Section 3 presents the design of the study, including the research questions, context and participants, learning assignment, implemented collaboration script, and methods of data collection and analysis. The results are presented in Section 5 and their implications are discussed in Section 6. Finally, Section 7 concludes the paper.

2. Related Research

According to Rummel and Spada [24, p. 210], "the main idea behind the usual application of cooperation scripts is to enforce a fruitfully structured interaction by giving precise instructions on how to interact and thus improve the joint problem-solving and knowledge acquisition". Five script components (*participants*, *activities*, *roles*, *resources* and *groups*) and three mechanisms (*task distribution*, *group formation* and *sequencing*) are normally distinguished [14]. Therefore, collaboration scripts can address several aspects to improve the process of collaborative learning. Scripts can regulate learning activities, provide complementary procedural knowledge, provide process-oriented instruction, alleviate coordination, and foster awareness [33]. For example, scripts may help students by breaking up the task in a row of more specific sub-tasks, modelling an effective strategy to cope with a task, distributing roles within a group, or distributing sub-tasks within a group.

One of the central challenges in CSCL is the lack of transactivity, that is, when learners are not able to build on the reasoning of their peers [33]. Earlier research demonstrates that it is common for groups who do not receive explicit guidance to reach the agreement quicker. When a suitable solution is proposed, group participants tend to agree on it without spending much time on considering the alternatives. This is referred to as "quick consensus-building" in CSCL research. While it is important for the learners to be able to continue the CSCL discourse, it may be negative for knowledge acquisition because the agreement is done to move on but not because the collaborators are convinced this is the right solution [35].

It has been empirically proved that collaboration scripts have much potential to improve collaborative learning [17], [22,23], [36]. At the same time, a few challenges have been identified by CSCL researchers. Over-scripting (i.e., providing too rigid structures that potentially disturb the natural flow of interactions) has been criticized [7], and it has also been proved empirically that scripts can limit reflective thinking [34]. Another crucial aspect that needs to be considered is students' internal scripts, that is, their current strategies used in collaborative learning situations [9], [16,17]. Moreover, the challenge in developing an effective script is in keeping it clear and concise. Often detailed instructions become long and increase the cognitive load for the students [7].

A recent meta-analysis demonstrates that learning with collaboration scripts leads to a large positive effect on collaboration skills [31]. However, there is only a small positive effect on domain-specific knowledge acquisition. Scripts have been found to be particularly effective for domain-specific knowledge acquisition when they ensured transactivity in student interactions and were combined with additional content-specific support, such as concept maps [31].

Empirical research has also demonstrated that transactive discussion scripts can facilitate both collaboration skills and domain-specific knowledge acquisition [24].

The focus of this paper is on the effects of a collaboration script introduced in an online collaborative writing activity. Earlier research demonstrates that collaborative writing tasks would often result in decreased levels of collaboration. For example, Munkvold and Zigurs [20] observed a team splitting up into two sub-groups and combining the results of both into the final report in the end. The final report looked more like a compilation of ideas from these sub-groups rather than an integrated document. Hadjerrouit [10] focused on the level of collaborative writing skills of teacher students by analyzing the actions that were carried out in a wiki environment, as well as classifying the comments posted by students. There was little evidence that students collaborated. Instead, they performed superficial actions such as formatting and adding links instead of reworking each other's contributions, which suggests that training is needed to ensure students know how to write collaboratively [10]. Wichmann and Rummel [36] introduced a collaboration script in a collaborative writing activity and found that scripted groups improved their revision behavior compared to unscripted groups, which resulted in better text coherence.

3. Research Design

This section introduces the research questions, describes the context and participants, clarifies the learning assignment and the implemented collaboration script, and finally introduces the methods of data collection and analysis.

3.1. Research Questions

The main objective of this paper is to examine the effects of a collaboration script on the learning process in a synchronous collaborative writing activity. The research questions are:

1. What types of collaborative interactions were most frequent in scripted and unscripted groups?
2. How did the collaboration process differ in scripted and unscripted groups?

We support our discussion by reporting on student perceptions regarding the clarity of the task instructions. In addition, we discuss how students perceived Google Docs as a tool for synchronous collaborative writing based on their blog reflections.

3.2. Context and Participants

The data were collected during one class in a bachelor course focusing on the use of ICT in teaching and learning, run by a university in the Nordic region. Most of the students were following either a bachelor program in IS or a teacher education program. Thirty-four students participated in the class.

The experiment was designed to include seven groups, with four assigned in the scripted condition, and three unscripted. However, due to technical problems with the chat logs (see Section 3.5) we did not get access to the data for two of the groups (one scripted and one unscripted). Thus, the final analysis included five groups.

Students in high familiarity groups were earlier found to have more positive perceptions of the collaborative process and fewer misunderstandings [9]. We assigned the groups randomly to avoid this effect.

3.3. Learning Assignment

Before the class, a pre-recorded video lecture and a set of materials were presented for the students to be studied beforehand in their course environment in Microsoft OneNote. The purpose of the video lecture was to provide some content background for the students to brainstorm individually and be prepared to discuss during the task with peers. The video lecture also demonstrated the basic affordances of Google Docs.

During the class, each group used their own Google document to write a collaborative paper, simultaneously discussing in the text chat. The participants did not meet physically. They were asked to be located at home to ensure they did not have the opportunity to work co-located. They were also asked not to use other tools during the discussion. Moreover, while the tutor was following the activity in each of the Google documents, students were asked to use each other for help and turn to the tutor only if considered necessary.

In the learning task, each group had to come up with a joint argumented solution to the provided case scenario (In the case, each group was asked to agree on a set of tools to be used for carrying out a collaborative project in a virtual team. The set had to include a shared file repository and tools for collaborative writing, asynchronous communication, and synchronous discussions). An important part of the learning task focused on argumenting the chosen solution. The solution was expected to be elaborated in the collaboratively written deliverable. Students had two hours to complete the collaborative task.

The participants were asked to reflect on the experience of the collaborative task on their individual blogs, including the task instruction, the tool used (Google Docs), and group work.

3.4. Collaboration Script

The collaboration script used was based on the jigsaw script principles. The main idea of the jigsaw script is the complementarity of knowledge. Each of the members becomes an "expert", or responsible for a sub-set of information [7]. Intentionally distributing various learning materials among the group participants may induce knowledge interdependence [31], so that input from each of the members is necessary to solve the task.

There are variations of the jigsaw script, and it may be not fully collaborative. In most jigsaw scripts students must work individually with specific sub-sets of information at some phases. However, when the parts of the whole are to be considered together, it is necessary for the students to interact collaboratively [7].

The implemented script included three main phases [24]: *initial*, *main* and *final*. The script suggested group participants to split the task in a way that each of the members would be individually responsible for a part of the final solution. Each participant would have time to find more information on the sub-task and propose it to the group. After having discussed each proposal and reached agreement on all of them, each participant would write up his or her individual contribution. This was followed by a structured revision involving all group members. The flow of the script is clarified in **Figure 1**.

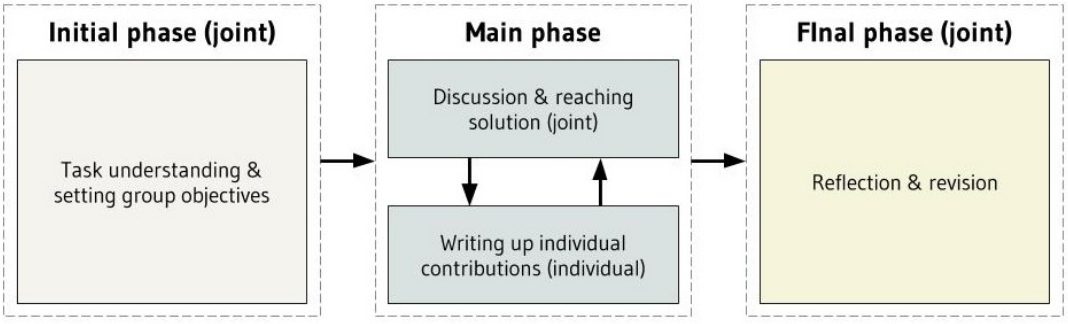

Fig. 1. Procedure of the implemented collaboration script

The script was presented as an extended instruction for solving the case, and following it was required for the scripted groups.

3.5. Data Collection and Analysis

The core set of data was the text chat logs of the Google documents. The chat logs were automatically shut down (without the possibility to retrieve the messages afterwards) in two of

the groups when the participants closed their Google documents. Therefore, the activity of five groups (three scripted and two unscripted; 25 students in total) is analyzed in this paper.

Qualitative content analysis, which is described as a method for the "subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns" [12, p. 1278], was used to classify the messages in the chat log. The aim of this method is to obtain a condensed description of a phenomenon with the help of descriptive categories [8]. A directed approach to content analysis (i.e., deductive content analysis) was chosen, where the existing framework helped narrow down the focus [12]. The analysis of the chat logs was carried out manually, without using qualitative analysis computer software. The coding scheme of Curtis and Lawson [6] who identify five main groups of collaborative interactions (in asynchronous learning context) was used (see **Table 1**). The coding scheme was modified accordingly to reflect the character of synchronous interactions. Categories "monitoring presence" and "emotion expression" were added as these kinds of interactions were observed rather frequently in all the five analyzed groups and did not fall under any of the categories formulated in the original coding scheme. The chat logs provided the process perspective on collaborative learning and made it possible to better understand the learning process of each group. Excerpts from the chat logs are used in the Results section to illustrate important learning interactions.

Second, we used the history logs from each of the five groups' Google documents to provide a brief overview of student activity in terms of the length of the activity and number of edits. Third, we used student individual reflections from the five groups to understand their perceptions of the activity. Finally, the deliverables were used to confirm if the outcome was in line with the group discussion and provided a complete solution to the learning task.

4. Results

An overview of the quality of collaborative interactions in each of the five groups is presented in **Table 1**. Each message sent on the text chat was coded separately into one of the sub-categories describing five main groups of collaborative interactions – *planning*, *contributing*, *seeking input*, *reflection and monitoring*, and *affective and social*.

Table 1. Overview of collaborative learning interactions in five groups

Category \ Group		Group 1 Scripted		Group 2 Scripted		Group 3 Unscripted		Group 4 Unscripted		Group 5 Scripted	
Planning	**OW**	78	68	132	125	41	39	34	30	116	102
	IA	(38,24%)	10	(38,15%)	7	(31,3%)	2	(22,67%)	4	(46,4%)	14
Contributing	**SK**	13	2	93	56	47	37	58	42	58	22
	FBG	(6,37%)	3	(26,88%)	14	(35,88%)	1	(38,67)	0	(23,2%)	2
	CH		2		6		0		0		4
	EX		0		0		0		0		2
	RES		0		1		0		0		5
	HEG		6		16		9		16		23
Seeking input	**FBS**	13	0	21	3	17	1	16	0	22	2
	HS	(6,37%)	5	(6,07%)	12	(12,98%)	11	(10,67%)	9	(8,8%)	13
	EF		8		6		5		7		7
Reflection & monitoring	**ME**	49	41	33	24	14	10	21 (14%)	11	28	22
	MP	(24,02%)	8	(9,54%)	9	(10,69%)	4		10	(11,2%)	6
Affective & social	**EM**	48	32	56	15	6 (4,58%)	5	11	10	18	11
	SI	(23,53%)	16	(16,18%)	41		1	(7,33%)	1	(7,2%)	7
Tutor		3 (1,47%)		11 (3,18%)		6 (4,58%)		10 (6,67%)		8 (3,2%)	
Total		204		346		131		150		250	

OW – organizing work; IA – initiating activity; SK – sharing knowledge; FBG – feedback giving; CH – challenging peers; EX – explaining & elaborating; RES – providing resources; HEG – help giving; FBS – feedback seeking; HS – help seeking; EF – advocating effort; ME – monitoring group progress; MP – monitoring presence; EM – emotion expression; SI – social interactions.

The scripted groups exchanged more messages on the text chat than the unscripted groups. In all three scripted groups, most messages were related to planning. In two unscripted groups, on the contrary, contributing behavior was the most frequent.

According to the students' blog reflections, most of the students (22 out of 25) had gone through the materials before the learning activity. This introduced new software and provided a brief overview of software they had known previously and could relate to. Students reflected that the materials served as a starting point for the group discussion and decision-making during the activity. One of the challenges some of the participants noted was that the group discussions were mainly based around the information that had been already known. In those cases, the provided learning materials did not have a significant impact on the activity.

The blog reflections also confirm that random group composition resulted in mixed familiarity groups. Regardless of the condition, students generally provided positive comments regarding the group work. Most of them perceived that they exchanged viewpoints and opinions on the subject. The groups were helpful in planning on how to split and carry out the task, and participants reflected that they could use each other as a source of knowledge.
All the groups but one – regardless of the condition – took the same time to deliver (see **Table 2**).

Table 2. Edits in group Google documents and time spent on the learning task. Note that a single edit may involve several actions as edits are auto- saved at specific intervals.

Group	Participants (N)	Condition	Edits (N)	Time spent
1	4	Scripted	72	102 min
2	5	Scripted	105	124 min
3	4	Unscripted	78	101 min
4	7	Unscripted	135	102 min
5	5	Scripted	128	98 min

Each of the delivered group papers was complete and provided a solution for the case suggested in the learning assignment. The chosen solutions, as well as the quality of argumentation differed from group to group. The main argument emphasized in the deliverables by Groups 1 and 3 was the participants' familiarity with the chosen software (followed by the discussion of the functionality). The analysis of the chat discussions also demonstrates that these groups did not even consider alternative solutions introduced in the pre-recorded video lecture. The deliverable by Group 4 focused on the functionality of the chosen software solutions; however, the chat discussion shows that familiarity with the chosen tools was the key, much the same as for Groups 1 and 3. Deliverables by Groups 2 and 5 focused on the functionality of the selected software. Only these two deliverables included examples of software that had not been known to the students previously, and that was considered and chosen due to better functionality over other (familiar) tools.

In the following sub-sections, each of the groups' learning process is described based on their text chat messages. We include example quotes from the students, identified by student number. In the final sub-section, we discuss student perceptions of Google Docs.

4.1. Group 1

In this group, the participants used the discussion chat primarily for organizing work on the task and monitoring the group results closer to the end of the activity. They also had a high amount of social interactions throughout the activity. However, they did not engage in much discussion. Messages in this group tended to be very short. Having split sub-tasks, students provided limited argumentation (if any) for their individual proposals, and did not seem to ever challenge each other during the discussion. After having written individual contributions, each of the students went through peers' work and agreed on the points provided without giving any additional commentary. Therefore, students in this group only partly followed the script. They used it for dividing the task in the beginning of the activity, and partly for revising the document in the end. They skipped the discussion part completely.

When reflecting on the task instructions, all the participants in the group commented that they were clear and easy to follow: "*I especially liked that the instructions were clarified step-by-step, indicating how many minutes we should use for each of them. That provided an overview and gave an indication in terms of how much commitment is expected in each step of the task* (S01)"; "*In the beginning I thought that the instructions were a little confusing. It was a lot of information at once, but then we started and everything became much clearer and easier. Thinking back, I believe the group would have been rather confused about how to solve the task without these instructions* (S03)".

4.2. Group 2

Although most of the behavior in the group was focused on organizing work, participants also demonstrated a high amount of contributing behavior. This group was the only one where feedback giving was rather active. Messages in this group tended to be elaborated, and students seemed motivated to engage in discussions and provide feedback to their peers.

However, participants in this group did not take time in the beginning of the activity to build a shared understanding of the task. Instead, they rushed into making suggestions right away. This caused confusion regarding the task requirements which resulted in the group taking more time to organize themselves. In a while, the participants realized the confusion and started following the script from the very beginning. In about 20 minutes after the start of the activity, one of the participants made sure the task was understood correctly by all in the end: "*So the task will be that […], I'm just thinking to make sure that everyone in the group is following* (S05)". The same student tended to reflect on the group's progress throughout the task, for example: "*It seems all of us are on the same page here* (S05)".

Further on, the participants followed the script carefully. After splitting the sub-tasks among the members, the group turned to sharing individual contributions and providing feedback to peers' arguments. The students were actively challenging each other. Importantly, in several cases the discussion led to revision of the group's product.

Moreover, the students in this group demonstrated a shared task understanding. Unlike other groups, they focused on the discussion in addition to writing up the solution: "*The main part of this task is about discussing with each other and finding the best alternatives* (S07)".

Regarding the task instruction, all the group members commented that they were clear and it was easy to understand how to split the task in stages. However, one of the students commented: "*In my opinion, the instructions about how to work in group work were unnecessarily detailed, but if it was meant as a suggestion for task delegation and use of time, then it's completely fine* (S08)". Another student mentioned that it could have been useful to suggest assigning the leader who would be responsible for delegating the tasks in the group.

4.3. Group 3

Most interactions in this group focused on the contributing type of behavior, with most of the contributions being somewhat more elaborated than those in Group 1. The group did not allow any time for planning in the beginning of the activity. The students did not delegate the sub-tasks among the members. They preferred to go through the case point by point and agree in the group on each part of the final solution, with one of the students taking on the leading role to walk the group through the task. The participants agreed on going for the solutions they were most familiar with (i.e., quick consensus-building).

When it comes to the clarity of the task instructions, all the participants reflected that they were rather easy to follow. However, two of them mentioned that it would have helped if they had an introduction describing what was supposed to be done (e.g., via Skype). This group was unscripted, which suggests that extra support by a script could have been beneficial.

4.4. Group 4

This group consisted of five students originally, and two more joining only for the final stage (due to access challenges). Sharing knowledge was the most frequent type of collaborative interactions in this group. However, following the chat transcript shows that the process was mainly about the group leader encouraging the rest of the group to contribute to specific parts of the final solution. Moreover, she would often suggest an idea herself, while the rest of the group would agree with it (although sometimes providing rather simple argumentation). Therefore, the same way as in Group 3, this group's discussion can be described as quick consensus-building. The group leader also took the responsibility of suggesting how to organize the rest of the work on the task (e.g., the writing part and submitting the deliverable).

According to the blog reflections from this group, task instructions were clear. The only negative thing mentioned by four out of five participants was the confusion regarding the tools for communication during the learning activity. In the beginning, it was unclear to them that only the functionality of Google Docs was to be used in for carrying out the task.

One of the students reflected on the lack of discussions in the group: "*We discussed rather briefly the difference between different solutions, but we did not discuss more than that* (S18)". This suggests that while students may be willing to engage in discussions they may be lacking an effective strategy to do so. Another explanation could be the tool used for communication as it was limited to text messages.

4.5. Group 5

Although the group was scripted, the participants did not seem to follow the script. The group took a very long time to understand what was expected to be done in the activity. In fact, the hesitation remained throughout the whole activity. There was much disagreement regarding the task requirements: "*Yes, but the way she writes implies that each of us should write about everything* (S23)" – "*No, each of us should choose to write about one [tool]* (S21)". The participants were not consistent in what they were doing, hence quite a few of their text exchanges were labelled as "initiating activity".

When the group moved on to the actual task, the participants did not argument much for their propositions. Much the same as for the participants in Group 3, they went through the case point by point and agreed on each part of the final solution without providing much argumentation. Although, one of the participants (S23) tried to challenge his peers twice when they suggested going for a well-familiar solution. Only in the second case the challenge was taken up and the solution revised. However, the group did follow the script in the end when they revised the document. Several revision comments led to edits improving the outcome.

Unexpectedly, the members in this group reflected that the instructions were easy to follow. Just one of the participants mentioned that in the beginning it was confusing, and that the peers' help was crucial in understanding the task. Moreover, there was a suggestion that having a group leader could have helped: "*[…] I would have chosen a leader. In our group, it took some time for members to understand what part of the task was assigned to them. If there was a leader assigned beforehand, this person could take some more responsibility. And he or she could also delegate the responsibility* (S25)".

4.6. Collaborative Writing in Google Docs

In their blogs, the students were asked to reflect on Google Docs as a tool for collaborative writing. There were both students who had used Google Docs previously and students without this experience. However, it turned out that none of the students used to synchronously co-write in Google Docs simultaneously using the text chat functionality. Quite a few students did not know about the chat function before the learning activity.

Most of the students were positive when commenting on the opportunity for the real-time synchronized collaborative writing. The opportunity to edit the text directly was much appreciated (although, there could be difficulties in following the changes when several people

were editing simultaneously). Most of the reflections on using the chat were positive. The students appreciated the opportunity to discuss real-time. It was especially emphasized that being able to ask peers for help on the chat was an advantage. The waiting time was very short and it was easy to get an immediate response. However, some described the chat as a limitation for their communication processes. These students expressed the opinion that it would work better if collaborative writing was combined with voice communication channels to avoid misunderstanding and reach a better flow.

Still, even though higher levels of social interaction are important for learning [6], [30], this should not become a distraction especially during short-term tasks. It was mentioned by the study participants that it is not that easy to talk about other things on the chat, so the whole discussion becomes task-oriented: "*I think that the chat function is much better than using Skype on the side, simply because there's a lot of non-task related stuff going on in Skype conversations* (S02)". Moreover, since everyone has the chance to contribute equally on the chat, it gives more opportunities for everyone to take the lead in the discussion.

Some other advantages of Google Docs pointed out by the students were:

1. Opportunity to collaborate effectively without having to meet face-to-face;
2. Only an invitation or a link to connect is needed to collaborate in the document;
3. Auto-save of the document in the process of writing;
4. Simple layout and navigation.

Some of the mentioned drawbacks were the following:

1. Bad spell check;
2. Not so advanced functionality when it comes to fine-tuning the documents.

One additional drawback that we identified ourselves during this study was that while the notes and the history log with individual edits are saved in Google Docs, the instant chat logs are not saved (and cannot be retrieved later). They need to be copied and saved elsewhere.

5. Discussion

To be able to transactively react to their peers' contributions, scripts may help learners coordinate discourse moves and prompt specific kinds of contributions [33]. The script was intended to divide the task to ensure knowledge interdependence and facilitate revision processes. It was expected that the scripted groups were going to avoid quick consensus-building more efficiently and demonstrate increased levels of contributing and monitoring behavior, which does not seem to be the case in our study (see **Table 1**). However, taking a closer look at the learning process in each group shows that two of the three scripted groups did not follow the script instruction properly.

Group 1 skipped the discussion part. The discussion in Group 5 was much the same as in the unscripted Groups 3 and 4. Only the students in Group 2 followed the script closely, challenging each other constructively. There was some degree of challenging also in Groups 1 and 5, however, in the same way as the unscripted Groups 3 and 4, Group 1 settled primarily with quick consensus-building on the solutions that were familiar to them. The challenging was partly taken up and reflected in the deliverable by Group 5; however, quick consensus-building was not uncommon in Group 5 either.

The only part of the script that was followed by each of the three scripted groups was the revision, while none of the two unscripted groups revised the deliverable before submitting. Revising a shared document is a demanding activity for students, as often they do not have a clear goal when revising their text [36]. Therefore, the script was effective in promoting students' awareness and guiding them through the revision process.

Cases with students not following the script have been reported earlier [23]. Students then claimed that they chose not to follow the script because it was too complex and they decided to approach the task their own way [23]. Although generally positive reflections were provided by the students in our study regarding the instructions, several comments indicated room for improvement in the way the script was presented. Moreover, the students' hesitation in the chat discussions suggests that the script could have been unclear or too demanding.

Clearly, the scripted groups required more effort to interpret and plan the task activities. This was an unexpected outcome as it was assumed that providing students with a strategy to cope with a task would reduce the coordination and prompt more contribution behavior. Also, Group 2 (the only group who followed the script properly) was the only group that took considerably longer time to finalize the deliverable. On the opposite, contributing was the most frequent type of collaborative interactions in the unscripted Groups 3 and 4 (see **Table 1**). However, assessing the learning process in these two groups demonstrates that participants provided limited argumentation (if any) to support their propositions and did not question or challenge each other's contributions.

Approaching the data through the lens of a qualitative inquiry in this study provides a valuable insight into the learning processes in a real online course situation. However, as any other study, it has its limitations. First, two of the chat logs were lost and could not be analyzed. Second, the short time of the task could have been a challenge. A fixed collaboration script may not be sufficient in synchronous collaborative writing settings, since the revision processes become more intertwined [36]. Third, while the text chat can be helpful to clarify specific points in the process of synchronous co-writing, not having any voice communication could have limited the discussions (at least in some of the groups). In tasks where much interaction needs to happen quickly, text chats can become time-consuming.

6. Conclusions and Future Research

The results of this study suggest that students in scripted groups used most effort on planning and organizing work in their groups, while students in unscripted groups used most effort on contributing to the case solution. This emphasizes the importance of the way the script is written and introduced, as collaboration scripts should not increase students' cognitive load.

At the same time, the results of this study suggest that closely following a collaboration script improved the quality of learners' discussions. The script was also effective in facilitating the document revision process in scripted groups. However, two of the scripted groups followed the script only partly and seemed to settle with quick consensus-building during the discussion phase, the same way as the unscripted groups. It was possible to keep the discussion part of the task on a rather superficial level and still produce an outcome. While each of the outcomes provided a complete solution to the case, the chat transcripts show that most of the groups did not consider alternative solutions which were less familiar. This suggests that more focus on transactivity in student interactions could have been necessary. In fact, a recent meta-analysis of studies on collaboration scripting suggests that scripts which do not prompt transactivity might not be optimal for learning [31].

Therefore, at least two directions for future work relevant for both fields of CSCL and IS can be identified. First, the same way as it is necessary to integrate technology in the curriculum considering subject matter and specific classroom contexts [15], collaboration scripts should be designed to facilitate learning activities in particular types of collaborative situations [31]. As mentioned earlier, IS research on collaboration engineering is focusing on designing collaboration patterns to be applied in the context of certain types of team tasks [32]. Lessons learned in collaboration engineering research have the potential to help CSCL researchers in designing collaboration scripts that would reduce learners' coordination effort and cognitive load during learning situations, thus helping them focus on the task at hand.

Second, the issue of transactivity can be addressed by assigning students specific roles to carry out during the collaborative learning task. Although roles may be understood differently in different disciplines, they serve as a common boundary [11], and are a crucial component for both IS and CSCL research. It has been demonstrated by IS researchers that mismatches between the role expectations of meeting initiators and participants are likely to happen. This may be a partial explanation why meetings fail to develop the way they are originally planned [37]. In CSCL, there has been much discussion about scripted roles as opposed to emergent roles [27], [29]. Analysis of chat transcripts in this study provided examples of emergent group leader behavior whose contribution to the group's coherence was crucial. Assigning specific roles to the students may improve the quality of collaborative dialogue. In addition to the role

to be carried out during the process of collaboration, students need to be provided with additional support to understand how to adopt the role effectively [19].

The focus of this study was on the quality of the collaborative learning process. In future, we aim at complementing the discussion by evaluating the outcome systematically. For example, the deliverable can be analyzed using a rubric (i.e., a set of evaluation criteria).

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