Scripting synchronous collaborative writing in second language education within a multi-shared visual workspace: a quasi-experimental study

S. Buseyne^{*}, A. Raes^{*}, B. Hurkmans, M. Leemans, K. Rajagopal, C. Eggermont and M. Montero Perez

Abstract This study explores collaborative writing in a multi-shared visual workspace, involving 76 students in higher education. We adopted the Activity-Centred Analysis and Design framework to describe our quasiexperimental design and the context variables. First, we studied the impact of a collaboration script on students' perceived quality of the group processes and the evaluated quality of their writing products. Findings revealed no significant differences in the overall quality of the group process and the overall writing product quality. However, when looking at the individual dimensions, groups using the collaboration script demonstrate significantly higher scores on the lexicon dimension. Second, the interaction with the shared visual workspace was studied. While participants expressed an overall positive perception of the multi-shared visual workspace and its benefits for joint coordination, the use of a collaboration script did not significantly impact students' perception of the shared screen's added value. This study enhances our understanding of the complexities involved in implementing collaborative writing within innovative learning spaces. Findings have implications for educators in creating effective computer-supported collaborative learning environments, considering different design dimensions.

Keywords collaborative writing; secondary language education; educational technology; scripting; ACAD

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1 Introduction

Recently, universities have started to design innovative learning spaces (ILS), as research shows that space matters for learning (Carvalho et al., 2020). However, research investigating how learning emerges within the ILS ecosystem is limited (Dillenbourg, 2021). Moreover, Wise and Schwarz (2017) indicate that research in authentic and ecologically valid settings is necessary to ensure that research findings influence practice.

One specific approach to learning taking place in these ILS is computersupported collaborative writing (CSCW)¹, both for first language (L1) and second language (L2) learning. CSCW is a process in which multiple individuals work together to produce a text, using digital technologies. It is considered a form of computer-supported collaborative learning (CSCL), a pedagogical approach focusing on facilitating and enhancing collaborative learning processes using digital technologies (Stahl et al., 2006). The complexity of CSCW processes within ILS requires careful consideration of various factors, including the suitability of writing task descriptions and the provision of specific instructions and scaffolds (Kessler et al., 2012). These scaffolds consist of, for instance, collaboration scripts to enhance interactions in collaborative learning. Scripts can include a set of guidelines, prompts, or instructions (i.e., roles, responsibilities, interactions) to structure and guide CSCW processes. In the specific context of CSCW, it remains unclear how these scripts can best be implemented and how they influence collaboration (Kollar et al., 2006). Therefore, the first objective is to investigate if a collaboration script could effectively enhance CSCW, both in terms of process and product performance.

Furthermore, the complex interplay between different dimensions of the ILS ecosystem makes it difficult for researchers and practitioners to design good CSCW experiences. One specific challenge lies in the effective use of educational technology (Kessler, 2009). In the past, collaborative writing was primarily conducted in pairs. Shared screens and visual workspaces now enable larger groups of students to collaborate effectively (Kessler et al., 2012). However, research focusing on students' use of shared screens is limited (Liu et al., 2009). Therefore, our second objective is to get insights into the students' perceived added value of the use of the shared visual workspace.

1 The abbreviation CSCW, as used in this article, refers to computer-supported collaborative writing and should not be confused with computer-supported cooperative work, a related research field.

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2 Theoretical Framework

Collaborative Learning and Collaborative Writing

Collaborative learning stems from a social constructivist perspective on learning and refers to a process in which two or more people try to learn something together (Dillenbourg, 1999). Within this perspective, it is stated that knowledge is constructed in social interactions. This is in line with Vygotsky's (1978) sociocultural perspective on learning, stating that the growth of cognitive abilities, particularly the development of advanced cognitive functions like voluntary attention, intentional memory, and language acquisition is socially situated (Storch, 2013). It has been found that the different perspectives individuals bring to the table, lead to better learning results (Schreiber & Valle, 2013; Storch, 2005; Van Steendam et al., 2016).

Collaborative learning can take many forms, one of which is collaborative writing. L1 and L2 collaborative writing have been predominantly studied and reviewed by Storch (2005, 2011, 2019), who defines collaborative writing as two or more writers jointly producing or co-authoring a text. Storch (2011) mentions three criteria for collaborative writing. First, there should be meaningful interaction in all stages of the writing process. Second, there should be shared decision-making power over and responsibility for the produced text. Third, it is one single-written document that is produced during the activity. In the process of writing together, participants should thus contribute to the planning and generation of ideas, debate about the text structure and about editing and revision (Storch, 2013), and engage in cognitive processes and meaningful communication (Shehadeh, 2011).

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Several studies highlighted positive results of collaborative writing. For example, Storch (2005) showed that more grammatically accurate and more linguistically complex texts were written by learners in pairs than by individual learners, because pair work enabled the participants to co-construct texts and pool their linguistic resources, a process that is called collective scaffolding. Furthermore, Donato (1994) found evidence that co-constructed knowledge during interactions was internalized and later used in independent activity by learners. In both studies (i.e., Donato, 1994; Storch, 2013), collective scaffolding enabled students to perform beyond their own level of linguistic expertise.

Supporting Collaborative Writing in L2 Education

Although there is evidence on the benefits of collaborative writing, it is also widely acknowledged that better learning outcomes, both in terms of process and product, are not always guaranteed (Radkowitsch et al., 2020; Webb, 2019). Yet, it remains unclear how to best support CSCW. In this study, we were particularly interested in current knowledge of supporting and enhancing the quality of L2 CSCW within co-located group work in a multi-shared visual workspace.

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Collaboration Scripts to Foster Positive Interdependence and Individual Accountability

Previous research (e.g., Kielstra et al., 2022; Putzeys et al., 2023) recognizes the need to know how groups can be supported to counter and eliminate imbalances and improve quality in collaboration. Positive interdependence and individual accountability are put forth by Johnson and Johnson (2009) as two essential elements of qualitative collaboration. This means that although there is a shared goal or mission, resources can be divided among group members and roles can be assigned to group members so that each group member is responsible for doing one aspect of the assignment, creating individual accountability and personal responsibility (e.g., Archer-Kath et al., 1994). Based on the Script Theory of Guidance of Fischer and colleagues (2013), we can state that collaboration scripts are found to foster collaborative learning by shaping the way in which learners interact with each other. A script specifies the activities learners are expected to engage in and assign appropriate roles to the learners. This way, collaboration scripts trigger engagement in social and cognitive activities that would otherwise occur rarely or not at all (Fischer et al., 2013). The theory distinguishes between internal collaboration scripts implying knowledge and strategies that learners bring to a collaborative situation, and external collaboration scripts which provide guidance by external sources like teachers or digital tools. According to the theory, a script can have four components from macro to micro level, i.e. play, scene, role, and scriptlet. Whereas the play component represents the overall structure and sequence of the collaborative activity, e.g. writing a short story collaboratively, is the scriptlet component a detailed instruction or prompts for specific roles or requested actions. Kirschner et al., (2018) stressed the need for guidance during collaborative learning to counteract the losses in the process caused by coordination demands. Two meta-analyses report positive effects of collaboration scripts on collaborative learning processes (Radkowitsch et al., 2020; Vogel et al., 2017). The meta-analysis by Vogel and colleagues (2017) showed that collaboration scripts have a positive and significant large effect on collaboration, which is predominantly operationalised as negotiation and information sharing, and a positive effect on domain learning. Radkowitsch and colleagues (2020) confirmed these findings and found a positive effect on both collaboration processes and domain knowledge. Importantly, they provided valuable insights into the impact of collaboration scripts on motivation-a topic of long-standing debate that began with Dillenbourg's (2002) article, who argued that (over-) scripting would lead to lower autonomy satisfaction. In addition, by limiting spontaneous interaction and personal input, over-scripting risks undermining students' intrinsic motivation by hindering their sense of control and agency (Dillenbourg, 2002; Wise & Schwarz, 2017). Radkowitsch and colleagues (2020), however, showed that the number of researchers

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STUDIËN https://doi. org/10.59302/6ncdjf17 incorporating motivation in their studies was rather small. Yet, qualitative analyses showed no negative or positive effect of collaboration scripts on motivation.

Moreover, Radkowitsch and colleagues (2020) argue that it is important to focus not only on whether collaboration scripts should be used but also on how to use them in an effective way, since scripts can be operationalized in different ways and can have different objectives. In line with earlier research (i.e., Mudrack & Farrell, 1995), three main categories of roles – as part of the script - can be distinguished: individual roles, task-oriented roles, and supporting roles. The individual category of roles comprises behaviours that are not pertinent to the task, lacking orientation towards group building or maintenance (Mudrack & Farrell, 1995). Task-oriented roles are important for the facilitation, coordination, and accomplishment of group problem-solving activities. Supporting roles, also referred to as group-building and maintenance roles, assist in strengthening, regulating, and perpetuating group-centred attitudes and orientations among group members. According to Strijbos et al. (2004), roles are either based on individual knowledge (i.e., content-oriented roles) or on individual responsibilities related to group coordination (i.e., process-oriented roles).

In addition, Strijbos (2004) and Strijbos et al. (2004) refer to functional roles which focus on the process of collaboration and how the interaction could take place. De Wever et al. (2010) showed that functional roles have a positive effect on knowledge sharing. However, the effect of using these roles faded when the task progressed. Saab et al., (2012) showed that scripts not only focus on knowledge acquisition but also on team regulation.

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When looking at scripting in L2 CSCW, only one study has been identified (i.e., Strobl, 2015), which focuses on online writing. The aim of this study was to assess the effectiveness of scripting, with a collaboration script based on Dillenbourg and Jermann (2007), and observational learning, in facilitating online collaborative synthesis writing in higher education. The results of this study demonstrated the benefits of both scripting and observational learning for CSCW.

To the best of our knowledge, there is no prior research investigating the impact of role assignment as part of a collaboration script on a synchronous face-to-face L2 collaborative writing task in a co-located multi-shared visual workspace.

Multi-Shared Visual Workspace

Collaborative writing is often done using technological devices (e.g., computers, tablets). Overall, a distinction can be made between two types of computer usage: (1) students share a single computer, fostering high levels of interaction and joint attention on the same screen, which limits equal participation and individual accountability as only one person can be the driver; and (2)

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all students work on their own personal device. This can however result in fragmented interaction patterns (Liu et al., 2009). In addition, as students concentrate only on their computer, their level of joint attention decreases (Scott et al., 2003). Yet, it has been stressed that both joint attention and individual accountability are critical for achieving a positive physical interdependence that stimulates discussion and continuous verbal exchange (Johnson & Johnson, 2009). A possible solution to these problems could be found in the use of screen sharing technology. Chen (2015), for example, studied the effect of using shared workspaces on collaboration. In his study, every group had one shared display that could be used to project the content of one mobile computer or to present the content on all the screens in the learning environment. Findings showed that the group screens made the students aware of the progress of the other groups and stimulated them to work harder and generate more ideas. Similarly, Chung et al. (2013) investigated learners' interactions in CSCW, supported in shared visual workspaces. Their results also indicate that the use of shared displays enhances students' interactions in collaborative learning processes and information exchange.

A second type entails the use of multi-shared visual workspaces, in which multiple screens can be shared and visualized on one shared display (see Figure 1). These multi-shared visual workspaces consist of a large, shared display on which multiple group members can simultaneously share their individual content and look at the shared screens of others. Because of hardware and software evolutions, this type of workspaces is more often being used in ILS. This technology contrasts with shared screen technology where only one screen can be shared at a time. In the context of CSCW, multi-shared visual workspaces enable learners to jointly revise a text and could foster shared (visual) attention within groups. However, to the best of our knowledge, little research is carried out on the use of multi-shared visual workspaces.

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Figure 1

Visualisation of the Multi-Shared Visual Workspace



Research Questions and Hypotheses

Two research aims form the basis of the current study. First, this study investigates the impact of a collaboration script with specific role assignments during a CSCW activity on learners' perceived quality of the group process and their actual group performance. To this extent, two research questions were formulated. The first research question (RQ1) is as follows: "To what extent does the use of a collaboration script influence learners' perceived quality of the group process?" Building upon previous research (e.g., Radkowitsch et al., 2020; Vogel et al., 2017), it is hypothesized (H1) that the use of a collaboration script will positively impact learners' perceived quality of the group process.

The second research question (RQ2) is the following: "To what extent does the use of a collaboration script influence the quality of the writing product?" Drawing on previous research (e.g., De Wever et al., 2010) and considering that the collaboration script explicitly includes task-oriented and functional roles we hypothesize (H2) that the quality of the writing product will be better in the condition using the collaboration script.

The second aim was to study students' perceived added value of the multishared visual workspace for CSCW and whether this was influenced by the use of a collaboration script. Again, two research questions were formulated. The third research question (RQ3) was as follows: "How do students perceive the added value of the multi-shared visual workspace?" No previous research was found on the use of multi-shared visual workspaces for CSCW and CSCL in general. We hypothesize (H3) that students will perceive the multi-shared visual workspace as adding value to the CSCW process. Specifically, we anticipate that students will value the simultaneous sharing and visualization of screens, fostering joint attention, and facilitating group awareness.

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The fourth research question (RQ4) was defined as follows: "Do student groups in the script condition perceive the added value of the multi-shared visual workspace differently compared to the control condition?" It is hypothesized (H4) that the use of a collaboration script will positively influence students' perceived added value of the shared screen technology. We assume that the script forces students to take up individual responsibility (e.g., looking for the correct vocabulary) and this interdependence may foster the need to share the individual screen on the group screen.

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3 Method

Context and Participants

The study was conducted in an educational lab setting during March and April 2018. Participants were second-year bachelor students (N = 76, typically around 18 to 19 years old) in Applied Economics at KU Leuven (Flanders, Belgium), enrolled in a French L2 core course 'Le français de la vie économique'. At the beginning of this course, students typically possess a French language proficiency ranging from A2 to B1 according to the common European framework of reference for languages (CEFR). By the course's conclusion, the goal is for students to achieve effective written and oral communication in French, in general and business contexts, at the B1-B2 level of the CEFR. As only 25 students could fit the collaboration room, the complete group of students was split up over four sessions. Each session lasted approximately two hours.

The study was ethically approved by the university's ethical committee (reference number G- 2018 04 1206) and participants signed an informed consent form at the start of the study.

Study Design and Procedure

A visual overview of the study's design is provided in Figure 2. Students were randomly assigned to a group of four to five students and the groups were randomly divided over two conditions (i.e., the script and control condition). Nine groups (i.e., a total of 38 students) were assigned to the script condition and nine groups (i.e., a total of 38 students) were assigned to the control condition. At the start of each session, students received an introduction to the task they had to perform, namely a CSCW activity further described in more detail. This instruction was followed by fill-out exercises in their syllabus. Next, they took a multiple-choice receptive vocabulary knowledge test (Peters et al., 2019), which was used as a proxy for French language proficiency. After filling out this test, the CSCW activity started. In what follows, the design of this activity is described based on the Activity-Centred Analysis and Design (ACAD) framework, which differentiates between three design dimensions: (a) set design, encompassing specific tools, artifacts, and learning spaces; (b) epistemic design, related to tasks or activities; and (c) social design, related to group composition (Goodyear et al., 2021).

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Figure 2

Visual Overview of the Design of the Study



Epistemic Design Choices

The main objective of the task was to describe in French a graph displaying the economic situation of different countries (see Figure 3) in a minimum of fifteen lines (i.e., about 250 words). Students were instructed to pay attention to linking words and to use specific vocabulary they had been taught in the French course. Students had 60 minutes to complete the writing task in Google Docs (see also set design). Upon completing the task, students were asked to share the link of their group task with the teacher who evaluated the tasks on the group level.

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Figure 3

Visualization of the Writing Task Graph



Set Design Choices

Students collaborated in a multi-shared visual workspace, displayed in Figure 1. Each student had a personal laptop to contribute to the group work and by using the MirrorOp software, students could share their individual computer screens through wireless connection on the group screen. Throughout the task, students were allowed to use all sources they wanted, including their personal notes, the syllabus, online dictionaries, etc. In the experimental condition (see social design), students got the paper-based description of the roles (see Appendix A). Students were asked to write the graph description in Google Docs and share it with the teacher at the end of the session.

Social Design Choices

During two out of four sessions, students were given a collaboration script providing five role descriptions (i.e., experimental condition), which they could freely assign among team members. During the remaining two sessions, the same task was given without the collaboration script (i.e., control condition). In the script condition, students were instructed to take up at least one role, meaning that in groups of four students, one student could take up two roles. Importantly, these different roles led to distinct epistemic design emphases, effectively assigning learners slightly different tasks based on their roles. The following roles were included in the collaboration script: content, grammar,

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lexicon, structure, and style. For a full description of each of the roles, a.k.a. scriptlets, we refer the reader to Appendix A.

Data-Collection and Analysis

Perceived Quality of the Group Process

In addressing RQ1, we evaluated the perceived quality of the group process after the experiment's completion, utilizing a questionnaire comprising seven dimensions rated on a 5-point Likert scale. The seven dimensions were selected from Meier et al.'s (2007) rating scheme for assessing the quality of CSCL, which has been used in various studies in the field of CSCL (Strobl, 2015). The following dimensions were included: sustaining mutual understanding, dialogue management, joint information and source processing, reaching consensus, task division, time management, and technical coordination. A detailed description of each dimension is provided in Appendix B. It was optional for students to abstain from providing ratings for one or more dimensions. The proportion of missing data for these dimensions ranged from 12-16 %.

The quantitative data analysis in this study was done using R (version 4.1.1). To assess whether there is a significant difference between the scores for perceived quality of collaboration between both conditions, t-tests were done for each of the dimensions. Due to the limited number of groups, multilevel analyses including a group level, were not possible (Leyland & Groenewegen, 2020).

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Quality of the Writing Products

To address RQ2, participants' language proficiency was measured prior to the experiment, since this could influence the overall task outcome. This was done using a receptive multiple-choice vocabulary test (Peters et al., 2019). This test was chosen for its suitability for Dutch-speaking French language learners. The average vocabulary knowledge (in percentage) was then calculated for each group.

Following the experiment, the quality of the writing product was assessed in different ways. First, each writing product was holistically scored by two experienced French teachers, based on content, grammar, lexicon, structure, and style.

Second, based on previous research (Barrot & Agdeppa, 2021; Pallotti, 2009; Wigglesworth & Storch, 2009), more detailed analyses were done on two indicators of linguistic performance and functional proficiency, i.e., complexity and accuracy.

Complexity was operationalized in terms of syntactic complexity, as measured by means of number of T-units and the number of words per T-unit (Barrot & Agdeppa, 2021; Ortega, 2003). A T-unit is the shortest unit "into which a piece of discourse can be cut without leaving any sentence fragments

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as residue" (Hunt , 1966, p. 737). For example, "The student completed the assignment" constitutes a single T-unit because it is an independent clause that can stand alone without leaving fragments. The following measures were included: the number of T-units in the text, the average number of words per T-unit occurring in a text, the number of T-units with dependent clause(s) per text, as well as the average number of dependent clauses per T-unit in a text. Complexity was also interpreted in terms of diversity (Michel, 2017), which is often measured using the type-token ratio (TTR). The TTR is represented by a score between 0 and 1. A TTR score of 0 indicates that all words in a text are similar, whereas a score of 1 indicates that all words in the given text are different (Thomas, 2005).

Accuracy was measured both in terms of grammatical and lexical accuracy (Barrot & Agdeppa, 2021). As a measure of grammatical accuracy, the number of words consisting of grammatical errors occurring in a text were counted and the proportions of errors per 100 words were calculated. Similarly, the proportions of lexical errors per 100 words were calculated.

Multiple regression analyses were conducted, using the aforementioned measures as outcome variables and controlling for the condition and vocabulary knowledge.

Perceived Added Value of the Shared Screen

To examine RQ3, a mixed-methods approach was used. First, at the end of the task, students were questioned about their perceived added value of the shared screen. Students were asked to rate the following statement on a 5-point Likert scale, ranging from strongly disagree to strongly agree: "The possibility to share individual screens during group work was an added value for this task". Missing data were observed for 21% of the participants.

Second, students were asked to react on this statement by writing a short text comment. Again, replying to this question was not mandatory, resulting in 22% non-respondents. A thematic analysis was done on students' textual responses.

To assess the subsequent research question (RQ4), whether there was a difference in perception of the added value of the multi-shared visual workspace between the two conditions, a t-test was conducted.

Use of the Collaboration Script as Manipulation Check

As giving a collaboration script does not guarantee the use of it, students from the experimental condition were explicitly asked in the questionnaire following the completion of the experiments to provide their reflections on their utilization of the collaboration script through a written comment.

Finally, to enhance the interpretation of the results provided by the different analyses mentioned above, students' written feedback on the use of the collaboration scripts was analyzed.

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4 Results

The Impact of a Collaboration Script on Learners' Perceived Quality of the Group Process

To address RQ1, students' perceived quality of the group process was measured based on multiple dimensions. Descriptive statistics for each of these dimensions, per condition, are presented in Appendix C, Table C1 and C2.

To test H1, the difference in learners' perceived quality of the group process in both conditions were compared using t-tests for each of the seven dimensions. Results of the t-tests are presented in Table 1. As the results indicate, none of the tests were significant, showing that learners' perceived quality of the group process, as measured through seven dimensions, did not significantly differ depending on the condition. Thus, these results do not support the hypothesis that a collaboration script could enhance the group process quality.

Table 1

Results of T-Tests for each of the Dimensions of Perceived Quality of the Group Process

Dimension	Ь	t	р
Sustaining mutual understanding	-0.27	-1.85	.07
Dialogue management	-0.37	-1.92	.06
Joint information and source processing	0.10	0.46	.65
Reaching consensus	-0.09	-0.45	.66
Task division	-0.22	-0.95	.35
Time management	-0.22	-0.98	.33
Technical coordination	-0.01	-0.05	.96

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Note. The control condition is the reference level. Due to missing responses, the sample sizes per dimension were as follows: Sustaining mutual understanding (n = 67), Dialogue management (n = 65), Joint information and source processing (n = 64), Reaching consensus (n = 64), Task division (n = 64), Time management (n = 64), Technical coordination (n = 64).

The Impact of a Collaboration Script on the Quality of the Writing Product

To assess RQ2, the extent to which the use of a collaboration script influences the group performance, the quality of the writing products was measured in several ways. First, a score on content, grammatical form, lexicon, overall text structure and style was given by the teacher. Descriptive statistics for each of these dimensions are presented in Appendix C, Table C3. Multiple linear regression analyses were performed to analyze the differences between the scores of both conditions, controlling for group vocabulary knowledge. Descriptive statistics of group vocabulary knowledge are also presented in Appendix C, Table C4.

The regression analyses, shown in Table 2, indicated no significant difference

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in the overall sum score between the control and experimental conditions after controlling for the group vocabulary knowledge. Similarly, for most of the underlying dimensions, i.e., content, grammar, structure, and style, the tests were not significant. However, one significant difference was found in the lexicon dimension. Specifically, the writing tasks in the experimental condition had higher scores in terms of lexicon compared to the writing tasks in the control condition. As expected, group vocabulary knowledge significantly influenced some of the scores, including the sum score and the scores on content, lexicon, and style.

Table 2

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Dependent variable	Intercept			Conditio	on		Group knowl	vocabu edge	lary	R2adj
	Ь	t	р	Ь	t	р	Ь	t	р	
Sum score	2.17	0.59	.56	-0.12	-0.12	.91	0.19	3.92	.001	.44
Content	0.24	0.21	.84	-0.44	-1.45	.17	0.04	3.04	.01	.33
Grammar	-0.31	-0.18	.86	0.23	0.49	.63	0.04	1.91	.08	.11
Lexicon	-1.26	-1.66	.12	0.54	2.61	.02	0.05	5.21	<.001	.68
Structure	1.79	1.87	.08	-0.28	-1.08	.30	0.02	1.91	.08	.12
Style	1.71	3.20	.01	-0.17	-1.16	.27	0.02	3.35	.004	.37

Results of Multiple Linear Regression Analysis for Each Dimension of Writing Quality of the Group Assignments (n = 18) as Assessed by the Teacher

Note. The control condition is the reference level.

Second, the texts were also assessed in terms of complexity and accuracy, using several indicators. A summary of the descriptive statistics for each indictor, organized by category (i.e., complexity and accuracy), is presented in Appendix C, Table C5.

To assess the differences between conditions for each of the dimensions, similar regression analyses were performed. The corresponding results of these analyses can be found in Table 3. The findings reveal that, after accounting for the vocabulary knowledge, there were no significant differences observed in terms of complexity between the two experimental conditions. No significant disparities were found in the accuracy of the writing tasks across the conditions. However, in the lexical accuracy model, the effect of condition approached statistical significance (p = .06), and uniquely explained 13.14% of the variance in lexical accuracy. Additionally, group vocabulary knowledge was a significant predictor for lexical accuracy.

Table 3

Results of the Multiple Linear Regression Analysis per Indicator of Complexity and Accuracy (n = 18)

Dependent variable	Intercept		Condit	ion		Group knowle	vocabula dge	ary	R2adj	
	Ь	t	p	b	t	р	b	t	p	
1. complexity										
TTR	0.53	6.79	<.001	0.01	0.26	.80	0.00	-0.49	.63	11
T-units	18.39	9.89	<.001	-0.01	-0.02	.98	0.00	0.19	.85	08
words/T-unit	13.70	9.94	<.001	-0.03	-0.08	.94	0.00	0.07	.95	10
T-units w/ dep. clauses	2.07	0.84	.43	-0.16	-0.22	.83	0.02	0.54	.60	11
2. accuracy										
grammatical accuracy	-1.28	1.54	.15	-1.28	-0.96	.36	-0.03	-0.54	.60	04
lexical accuracy	16.76	4.95	<.001	-1.98	-2.06	.06	-0.15	-3.33	.01	.47

Note. The control condition is the reference level. Higher scores for grammatical accuracy and lexical accuracy indicate a greater number of errors, reflecting lower accuracy.

Students' Perceived Added Value of the Multi-Shared Visual Workspace

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Consistent with H3, the analysis of student ratings indicated a generally positive perception regarding the added value of using the shared screen, with an average rating of 3.55 (SD = 0.81) measured on a 5-point Likert scale. Overall, this was partially supported through the quantitative data. Specifically, in the written feedback, two recurring themes could be identified. First, eighteen participants referred to the fact that shared screen use was useful and/or fosters joint coordination. For example, participants mentioned that "it can be useful to have an overview of what everyone is working on" or that "it was easy to see what everyone was doing behind their screens". These examples point to the advantages for becoming aware of what others are doing. However, when further examining these results, a nuanced perspective emerges, as 21 participants mentioned that the use of a shared screen did not provide substantial additional benefits due to their utilization of Google Docs. For example, participants wrote: "Screens are useful, but when you're working in Google Docs, you already see the same screen"; "We were working through a Google Doc, so it was not really necessary to share screens"; "We had Google Docs, so I found those screens useless"; and "the screens did not provide such a big added value because on Google Docs, you can already see who is writing what". In other words, students focused on the Google Docs to become aware of what the others were doing, which made the use of the multi-shared screen redundant.

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Regarding RQ4, the participants in the control condition without script reported an average score of 3.71 (SD = 0.76). In the experimental condition, participants reported an average score of 3.41 (SD = 0.84). Contrary to H4, the t-test conducted to examine the potential variations in the perceived added value of the multi-shared visual workspace did not yield any statistically significant differences (t = -1.48, p = .14).

Use of the Collaboration Script

To assess the extent to which students were satisfied and made use of the assigned roles, a thematic analysis of their written feedback regarding the use of the roles was conducted, which is based on 29 responses from students in the experimental condition. Among the feedback given by students, three recurring aspects emerged.

Some of the roles were identified as more important for the type of task they needed to perform. This was explicitly mentioned by three participants. For example, one of the participants stated that "with role distribution, the role of some is more important than others". Two other participants referred to the role of structure: "I think the role of structure is slightly more important than the others. Structure does a lot in a text. I believe the function of the 'timekeeper' is unnecessary for these short-term projects"; and "I found the structure quite important since the structure practically determines the entire text".

Furthermore, five students mentioned that their engagement with tasks went beyond their assigned role. For example, one student mentioned: "I had to take care of the structure, but since some didn't do their task well, I also had to do other things like content". Another student mentioned: "I didn't only focus on vocabulary; for example, when I saw grammatical errors, I also corrected them myself".

Overall, there were also recurring positive sentiments towards the roles. Six students found them useful in ensuring specific aspects were addressed, such as the verb conjugations, article usage, and maintaining coherence. For example, a student mentioned that "It was beneficial that everyone could focus on one specific thing". Another one mentioned that it was "very useful, also to maintain the necessary speed in the task. However, there was also one student who would rather have preferred not having assigned roles: "I find it more convenient if there are no assigned roles".

5 Discussion

The aim of the present study was twofold. First, it investigated the impact of a collaboration script on learners' perceived quality of the group process and their actual group performance in a CSCW task in L2 education. Second,

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it assessed students' perception of the added value of a multi-shared visual workspace and whether this changed according to whether student groups used the collaboration script or not. In what follows, we present a summary and interpretation of the results for each research aim, discussing implications. Subsequently, we address certain limitations and identify potential avenues for future research.

The Use of the Collaboration Script

Overall, contrary to H1, the use of a collaboration script did not positively influence students' perceived quality of collaboration (see RQ1). Moreover, for sustaining mutual understanding and dialogue management the effect approached significance, but in the opposite direction. Next, regarding the impact of the collaboration script on the quality of the writing product (see RQ2), groups using the collaboration script did, overall, not outperform the groups in the control condition, when considering the group vocabulary knowledge. Only one significant difference was found in terms of lexicon, showing that the experimental condition yielded higher scores in terms of lexical diversity compared to the control condition.

The current research aligns with one of the assertions put forth by Radkowitsch et al. (2020), emphasizing the importance of exploring effective ways to implement collaboration scripts rather than solely debating their necessity. As has been shown earlier, scripting for CSCW using group roles, can be operationalized in multiple ways aiming for knowledge sharing (e.g., De Wever et al., 2010) or rather team regulation (Saab et al., 2012). It is, therefore, not surprising that the current results may deviate from earlier findings (Vogel et al., 2017). One prominent reason for the lack of significant results, therefore, might lay in the way the roles were defined and implemented. In the current research, task-specific roles were defined in line with the language generation processes of the CSCW task. Upon reviewing students' experiences with these roles, concerns were raised about the definition of certain roles. Specifically, some roles were perceived as more crucial, suggesting opportunities for improving the script.

The Use of the Multi-Shared Visual Workspace

In line with H3, the quantitative and qualitative results indicated an overall positive perception of the added value of the multi-shared visual workspace. Part of the participants acknowledged the benefits of using the shared screen for joint coordination. Yet, contrary to H4, no significant difference was found in the perceived added value of the multi-shared visual workspace between groups in the script and control condition, indicating that the collaboration script did not significantly influence students' perception of the shared screen's value. Although it was hypothesized that students in the script condition

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would be more inclined to use the shared screens because of their individual responsibilities (e.g., opening certain apps to check for synonyms), we did not find evidence supporting that hypothesis. Qualitative results helped us to interpret these results, as several students revealed that the use of Google Docs already provided real-time visibility of modifications and identification of contributors on the individual screens. This may also have limited the overall perceived added value of the shared screen, which relates to H3.

These findings highlight the complexity of studying CSCW and learning in general (e.g., Wise & Schwarz, 2017). In line with the ACAD framework, this result shows that different (set) design choices interact with each other, determining emergent student learning activities together. Although the manipulation was clearly situated in the social design, with the students in the experimental setting having a collaboration script and the students in the control condition not having specific guidelines to structure their collaboration, we hypothesized that this would also influence how students would deal with the given task (i.e., set design) in the context of the multi-shared collaboration room (set design). We assumed that multi-shared screens could have an added value for students (H3), especially in the script condition (H4), but no evidence was found for that. We had not considered how the interaction with Google Docs (i.e., set design) could have influenced the emergent learning activity within the learning environment. As indicated by (Carvalho & Goodyear, 2014; Goodyear et al., 2021), this not only shows the complex interplay between the different design dimensions and the emergent activity, but also the complexity within each design dimension.

Limitations and Future Research Opportunities

When interpreting the results of this study, it is important to consider some limitations. First, the sample size and missing responses may limit the generalizability of the findings. Future research could explore the current findings in different contexts and larger samples for robustness and applicability of the conclusions drawn.

Second, there are limitations regarding the validity of the instruments used in this study. Only the VocabLab test has been thoroughly validated (Peters et al., 2019). Validation of the remaining instruments would be beneficial to ensure the accuracy and reliability of the measures. Furthermore, this study predominantly relies on self-reported data, which introduces limitations in capturing participants' actual behaviors. Future research could address this by triangulating the findings with observational data.

Third, looking into the effect of the condition on the quality of the writing tasks, it is important to note that we only controlled for vocabulary knowledge. Considering additional characteristics related to language proficiency, such as average grammar proficiency in the group or motivation towards the task

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performance, would be beneficial for future research. In addition, not all group sizes were equal. Future studies could consider this limitation by adapting the group compositions based on these variables. Additional team characteristics could be considered, such as gender balance and group familiarity (e.g., Cukurova et al., 2018, Putzeys et al., 2023; Su et al., 2024). This would permit to investigate group composition factors which influence the quality of CSCW.

Fourth, within the scripting condition, students were instructed to utilize the assigned roles, while all students were given the opportunity to utilize the shared screen. In our study, we conducted a form of manipulation check by explicitly asking students about their utilization of the script. However, we did not assess students' satisfaction with the assigned roles or whether these roles aligned with their individual competencies. This aspect may also have influenced the effectiveness of the scripting intervention and, hence, the results of the study. Therefore, further research is needed which considers these aspects of role allocation. Furthermore, future research could also focus on observational data, to explore the extent to which students genuinely utilized the shared screen and the roles provided within the script condition. This consideration aligns with the concept of instructional disobedience (Elen, 2020), which arises when learners deviate from the intended usage of learning tasks or fail to effectively utilize the provided support. Subsequent research endeavors should, therefore, evaluate whether and how students actively engaged with the roles and technologies that were made available.

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Fifth, although students were asked to reflect on shared screen use, this study did not explicitly investigate the effect of using a multi-shared visual workspace on the collaboration process. To be able to test this effect a within-subject design is needed in which participants can experience CSCW with and without the multi-shared screen sharing technology. Based on prior research on technology acceptance (Raes & Depaepe, 2020), we also assume that once students are used to a certain technology, the perceived usefulness and the intention to use the specific technology will increase.

Sixth, as has been shown in the current study, the use of both Google Docs for real-time document editing and shared screens for simultaneous visibility of the individual workspaces may introduce an unnecessary complexity or redundancy. It might be worth exploring a more streamlined approach, where a single person takes on the role of the driver. Other participants could then navigate through additional resources (e.g., to search for information). Again, these screens could be shared with all group members. Using such an approach, future research could delve into optimizing the integration of collaborative tools to achieve a balanced and purposeful workflow, ensuring the alignment of the different dimensions of the ACAD framework.

Last, as shown by Kirschner et al. (2018) the complexity of the task itself is of importance when studying CSCL. Consequently, task complexity might

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also influence the utility of multi-shared screens in CSCW. As task complexity increases—such as when multiple data sources or datasets are involved—the value of a multi-shared screen could become more apparent. Future research could investigate at what task complexity level a multi-shared screen adds value, enhancing collaboration without redundancy.

6 Conclusion

This study aimed to explore the impact of collaboration scripts and multi-shared visual workspaces on CSCW in L2 education within ILS. The findings suggest that the use of a collaboration script did not significantly enhance students' perceived quality of the group process or the overall quality of the writing product. However, a notable positive effect was observed in terms of lexicon, indicating that scripting can influence specific aspects of writing. Additionally, students perceived the multi-shared visual workspace as a valuable tool for collaboration. These results highlight the complexity of collaborative writing in ILS, emphasizing the interplay between different design elements (e.g., technological tools and social dynamics). Future research should focus on optimizing script implementation and understanding the role of multi-shared visual workspaces to enhance collaborative writing experiences.

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Additional information

This manuscript is accompanied by supplementary materials which can be found in the appendix section.

Data availability statement

The data and syntax for data analyses used in this study are available upon request from the first author.

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Appendices

Appendix A

This Appendix includes a description for each of the roles included in the study (see Table A1).

Table A1

Translated Version of the Role Descriptions

Role	Description	
Content	The student who takes on this role focuses mainly on the content of the text: The reference framework (answering 3 questions: What? Where? When?) Distinguishing between main points and details in the text Adding a rich and interesting conclusion Checking that all elements of the graph are discussed The student is also responsible for typing the text in Google Docs	
Grammar	The student who takes on this role focuses mainly on the grammatical aspects in the text: Verb conjugations: are all verbs conjugated correctly (cf. Toledo: Course Documents / Conjugation)? The use of the correct "temps" (tense) and "mode" (mood) of the verb Respecting the "accords" (agreements) (subject - verb / past participle) Verifying the gender of nouns (Robert / Van Dale)	
Lexicon	The student who takes on this role focuses mainly on the lexical elements in the text: The use of a varied vocabulary Correct use of verbs (syllabus pp. 113 and 118) and collocations (pp. 113-114 and pp. 118-119) Expressions to express nuances (syllabus p. 111, p. 120) Adding correct prepositions (syllabus pp. 137-139)	52 pedagogische studién
Structure	The student who takes on this role focuses mainly on the structure of the text: A plan is first developed before the text is written out The end product is a structured text with adequate division into paragraphs The «critères d'organisation» are checked (cf. syllabus pp. 131-132) Do not forget: enough connectors (5 nice connectors) and proper (meaningful) use of connectors (syllabus pp. 158-170) The student who takes on this role is also the "time-keeper" and keeps an eye on the timing.	https://doi. org/10.59302/6ncdjf17
Style	 The student who takes on this role focuses mainly on the style of the text: The text conforms to the style of a written text (registre écrit) Synonyms are sought to avoid repeating the same structures (e.g. Beaucoup de) too much in the text (pp. 110-111) The following structures are avoided: Il y a, on a (cf. syllabus page 136); also avoid words like chose, gens, faire Infinitives used as nouns (= not a correct French structure). E.g. «vendre est une tâche difficile» is not a correct French sentence -> la vente constitue une tâche difficile Concise and business-like style, but also pertinent content and sufficient nuance. 	

Appendix B

An overview of the different dimensions included in the questionnaire measuring students' perceived quality of the group process is provided in Table B1.

Table B1

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PEDAGOGISCHE STUDIËN https://doi. org/10.59302/6ncdjf17 Overview of the Assessed Dimensions in the Group, Peer and Self-Assessment Tool

Dimension	Description
1. Sustaining mutual understanding	Every member of the group effectively com- municated their individual contribution in a manner that was both clear and comprehensi- ble to their fellow peers. Furthermore, feedback was provided to one another, and if necessary, additional explanation was requested to ensure a thorough understanding of the contribution.
2. Dialogue management	There was a smooth flow of communication within the group. Communication was carried out efficiently, without confusion regarding who could speak at what time.
3. Joint information and source process	sing As much information and resources were used as possible to successfully accomplish the task at hand.
4. Reaching consensus	Consensus was reached through shared focus and the opinion of all group members was valued.
5. Task division	There was a clear task division, individual sub-tasks were defined, and there was a good alteration between working in group and wor- king individually.
6. Time management	The timing was monitored to ensure that the task could be completed within the available time.
7. Technical coordination	The technological support tools, especially the screen sharing, were used in an efficient way.

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Appendix C

This appendix provides descriptive statistics for the study variables per condition. First, Table C1 includes the descriptive statistics for different dimensions of the perceived quality of the group process. The average values per group for these dimensions are shown in Table C2.

Table C1

Descriptive Results for Perceived Quality of Group Process Dimensions

	Contr	ol condit	ion	Exper	Experimental condition		
Dimension	Ν	М	SD	Ν	М	SD	
1. Sustaining mutual understanding	33	4.21	0.55	34	3.94	0.65	
2. Dialogue management	32	4.10	0.73	33	3.73	0.80	
3. Joint information and source processing	31	3.32	0.91	33	3.42	0.87	
4. Reaching consensus	31	4.03	0.87	33	3.94	0.79	
5. Task division	31	3.61	0.76	33	3.39	1.06	
6. Time management	31	4.19	0.87	33	3.97	0.95	
7. Technical coordination	31	3.71	0.90	33	3.70	1.16	

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Table C2 Average Group Scores for P	erceived	Quality	of Grou	up Proc	ess Dim	iensions												
Group Dimension	~	2	m	4	ى ا	9	7	8	6	10	Ħ	12	13	4	15	16	17	18
1. Sustaining mutual understanding	4.60	4.25	4.00	4.25	4.00	4.00	4.75	4.20	4.00	3.67	3.00	3.00	3.50	4.25	4.25	3.75	4.50	4.00
2. Dialogue management	4.40	4.00	4.50	4.00	3.00	3.80	4.25	3.40	4.00	3.33	4.00	3.50	3.25	4.00	4.50	3.33	4.50	3.33
 Joint information and source processing 	3.60	4.00	3.00	4.00	4.00	3.00	4.00	4.00	4.00	2.33	3.00	3.00	3.50	3.25	3.50	2.00	3.00	2.67
4. Reaching consensus	4.60	4.25	4.33	3.25	5.00	4.00	4.50	4.20	3.75	3.67	3.50	2.50	3.76	4.50	4.00	3.67	4.25	3.33
5. Task division	4.00	3.75	4.00	4.25	4.00	2.20	4.50	3.80	3.00	3.00	3.00	2.00	4.50	3.75	3.50	2.33	4.00	2.33
6. Time management	4.80	3.50	4.33	3.75	5.00	4.80	3.50	4.60	4.00	3.00	2.50	4.00	3.50	4.50	4.50	4.33	4.50	4.67
7. Technical coordination	3.60	3.50	3.67	2.75	4.00	3.20	5.00	4.20	4.00	3.00	2.50	3.50	3.50	3.50	4.50	3.33	4.25	4.00

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Second, the descriptive statistics for the holistic scores on the writing products, assessed by teachers, are presented in Table C3.

Table C3

Descriptive Variables of the Holistic Scores on the Writing Products

	Control condi	ition	Experimental con	dition
Variable	М	SD	М	SD
1. Sum score	15.44	2.96	15.78	2.77
2. Content	3.00	0.71	2.67	0.87
3. Grammar	3.00	1.22	3.33	0.87
4. Lexicon	3.00	0.71	3.67	0.71
5. Structure	3.22	0.44	3.00	0.71
6. Style	3.22	0.44	3.11	0.33

Third, Table C4 provides an overview of the descriptive statistics for group vocabulary knowledge.

Table C4

Descriptive Variables of the Group Vocabulary knowledge

	Control con	dition	Experimental con	dition
	М	SD	Μ	SD
Group vocabulary knowledge	72.10	11.66	75.14	8.56

Fourth, Table C5 includes the results of the descriptive analyses for the group performance dimensions.

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Table C5

Descriptive Results for the Group Performance Dimensions

	Control condit	ion	Experimental cond	lition
Indicator	М	SD	М	SD
1. complexity				
a. TTR	0.49	0.03	0.50	0.06
b. T-units	16.22	3.23	15.11	2.67
c. words/T-unit	12.52	2.45	12.06	1.83
d. T-units with dependent clause(s)	1.10	0.16	1.21	1.20
2. accuracy				
grammatical accuracy	4.78	3.14	3.42	2.32
lexical accuracy	5.69	3.36	3.34	1.46

Note. Higher scores for grammatical accuracy and lexical accuracy indicate a greater number of errors, reflecting lower accuracy.

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Samenvatting

Samenwerkend schrijven in het vreemdetalenonderwijs met behulp van een script in een gedeelde visuele werkruimte: Een quasi-experimentele studie

Deze studie verkent samenwerkend schrijven in een gedeelde visuele werkruimte waarbij 76 studenten uit het hoger onderwijs betrokken waren. We maakten gebruik van het Activity-Centred Analysis and Design raamwerk om ons guasiexperimenteel ontwerp en de beïnvloedende contextvariabelen te beschrijven. Ten eerste werd de impact van een samenwerkingsscript op de gepercipieerde kwaliteit van de groepsprocessen en de kwaliteit van de schrijfproducten bestudeerd. De resultaten toonden geen significante verschillen noch in de kwaliteit van het groepsproces, noch in die van het schrijfproduct. Groepen die gebruik maakten van het samenwerkingsscript behaalden wel significant hogere scores op de lexicon-dimensie. Ten tweede werd de interactie met de gedeelde visuele werkruimte bestudeerd. Hoewel deelnemers over het algemeen een positieve perceptie hadden over de multi-gedeelde visuele werkruimte en de voordelen ervan voor gezamenlijke coördinatie, had het gebruik van een samenwerkingsscript geen significante invloed op de perceptie van studenten over de toegevoegde waarde van de multi-gedeelde visuele werkruimte. Deze studie verhoogt ons begrip van de complexiteit van de implementatie van samenwerkend schrijven in innovatieve leeromgevingen. De studie levert praktische implicaties voor docenten en ontwerpers van effectieve leeromgevingen voor computerondersteund samenwerkend leren, rekening houdend met verschillende ontwerpdimensies.

Kernwoorden samenwerkend schrijven; vreemdetalenonderwijs; educatieve technologie; script; ACAD

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