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Collaborating on a Shared Document: Vocational and Technical Students' Approaches and Experiences.

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Abstract: In computer-supported collaborative learning (CSCL) environments, students often need to collaborate on a shared document while they are geographically separated. In this context, coordinating their group work and interacting with each other about the content of the task are prerequisites for successful collaboration. Therefore, the present study aims to gain insight in vocational and technical students' group work coordination and interaction strategies to jointly write a document. Four groups collaborated on a shared document during four weeks and communicated about their task through chat, e-mail, and/or comments in the document. Two specific tools were implemented to stimulate the coordination of the group work: students were required to (a) collaboratively plan their work, and (b) self-assess their product using performance standards. The following research questions are addressed: (1) How do small groups of vocational and technical students coordinate their group work to collaborate on a shared document? How is this group work coordination strategy related to the use and perceived usefulness of the (1a) planning and (1b) self-assessment tools? And (2) how do these students interact with each other to compose the shared document? Data from multiple sources were collected: activities related to the production of the online document were logged through the revision history, interaction between students was captured, and students were interviewed to gain insight in how they experienced the collaboration and interaction process, as well as the planning and self-assessment tools. The results show that, first, all groups used a different strategy for group work coordination. In addition, despite the implementation of the planning tool, the majority of the groups did not decide upon a specific strategy to tackle the task in advance. Moreover, the self-assessment tool did not seem to stimulate the groups to reflect on their task and to reach consensus about the final product. Second, there was a low level of online interaction between students, and two groups decided to meet each other face-to-face. Finally, implications for further research aiming at providing optimal instructional support for vocational and technical students to enhance the collaboration and interaction processes in CSCL are discussed.

Keywords: Group work coordination; online interaction; computer-supported collaborative learning; vocational and technical students; collaborative e-learning; educational technology.

1. Introduction

The production of shared documents by students that are geographically separated is one of the most common collaborative tasks in computer-supported collaborative learning (CSCL) environments (Makos, Lee & Zingaro 2015). In this context, collaborative learning appears to be most effective in improving performance when group members collectively decide on and regulate their work (Panadero et al, 2013), and co-construct knowledge based on content-related discussions (Mayordomo & Onrubia 2015). At the same time, these two aspects are often hard to realize during collaborative learning, which makes that they are one of the major interests in the research field of CSCL. In the remainder of this introduction, we elaborate upon both group work coordination, and online interaction.

Previous research has indicated that several strategies to coordinate and regulate group work exist, focusing on who does what, when, and how this is related to what the others are doing (Onrubia & Engel 2012). In particular, Onrubia and Engel (2009, 2012) identified three strategies of coordinating group work in a collaborative writing task: (1) *jigsaw coordination*: the group decides to share out different parts or aspects of the task, and the final document is constructed through juxta positioning of these different parts; (2) *chain*

coordination: one group member contributes a partial or complete solution for the task, and the other group member(s) successively add their contributions to this initial document to produce the final document; and (3) *star coordination*: the group decides that they will all individually produce an initial document with the entirely or partially completed task, and based on these individual contributions they will all compose the joint document. However, previous research has pointed out that student groups often fail to coordinate their work and need support for regulating their learning (Zimmerman 2002; Panadero et al, 2013). For this reason, studies in the field of CSCL have been focusing on instructional interventions to improve the collaboration between group members (Onrubia & Engel 2012; De Wever et al, 2015; Järvelä et al, 2015). In particular, previous research has emphasized that the implementation of tools to prompt students to *plan* their collaboration, and to *evaluate* their collaboration and final product against performance standards; can help students to regulate their collaboration process (Panadero et al, 2013; Järvelä et al, 2015).

The above described strategies for group work coordination also have an impact on the amount of reciprocity and mutual revision between the group members (Mayordomo & Onrubia 2015), and thus on the interaction between the group members. For instance, a *jigsaw coordination* strategy is often associated with few reciprocity and mutual revisions, while a *star coordination* strategy often involves more reciprocity and mutual revision (Mayordomo & Onrubia 2015). Related to this, previous work in the field has shown that groups often do not naturally reach the highest levels of knowledge construction (Onrubia & Engel 2012). In this respect, groups have to decide how they will interact with each other, and need a shared space to facilitate interaction between the group members in the online environment. Previous work in the field has argued that learners should be familiar with the technology used, to avoid technological barriers (Stahl 2005).

Up until now, however, there has been few research focusing on instructional interventions in CSCL in vocational and technical settings (Hämäläinen & De Wever 2013; Schwendimann et al, 2017). In particular, the question arises how this target group actually collaborates on a shared document, and experiences their collaboration process. This target group distinguishes itself from students in higher education, as they may have more difficulties to self-regulate their learning (Räisänen, Postareff & Lindblom-Ylänne 2016), which may cause that these students encounter more problems in learning environments with a high degree of learner autonomy, such as the implementation of CSCL tasks in an online environment (Barnard et al, 2009).

2. Research questions

The aim of this study is to determine both the forms of collaborative work and interaction patterns developed by the groups to find out which kind of support is needed for vocational and technical students. As such, the research questions are: (1) How do small groups of vocational and technical students coordinate their group work to collaborate on a shared document? How is this group work coordination strategy related to the use and perceived usefulness of (1a) the planning and (1b) self-assessment tools? And (2) how do vocational and technical students interact with each other in the online environment to collaborate on a shared document?

3. Method

This study was part of a design-based research (DBR) project about the (re)design of blended learning arrangements for teacher training within adult education. Participants were students with a degree of vocational and technical secondary education, i.e. future vocational subject teachers, enrolled in the course ‘psycho pedagogical competences’. The first author and the teacher collaborated to design, realize, and evaluate several learning tasks in the course to ensure that the intervention fits in an authentic classroom and addresses a concrete educational need (McKenney & Reeves 2012). The present study focused on one specific learning task of the DBR project, a CSCL task, which is described in detail below.

3.1 Instructional design of the learning task

The CSCL task started with a presentation of a case of a pupil with a learning or developmental disability, and students were required to search for information about this specific disability. They received a template of the document (i.e. process worksheet) to structure the task, which consisted of seven steps with underlying questions. To stimulate students to coordinate their group work, a planning and self-assessment tool were implemented. First, during an introductory face-to-face meeting, students were asked to plan their work (prior to task execution). Each group had to establish and develop their own strategy of collaborative work, making decisions regarding the planning and execution of the process worksheet. Second, after performing the task, each group had to assess their product on the basis of a checklist indicating the performance standards, and students also had the opportunity to make improvements. The implementation of these tools was based on the idea of OurPlanner and OurEvaluator by Järvelä et al (2015).

After the introductory face-to-face meeting (which included organizational information about the task and a worked-out example), students had four weeks to complete their CSCL task. Students collaborated in a shared Google document and could choose their preferred medium to interact with each other during the task (e.g. comments in the shared document, chat, or e-mail). As such, we wanted to be sure that students felt comfortable with the used technology to ensure interaction. After four weeks, the teacher provided students with feedback related to their task.

3.2 Data collection

Participants in this study were five male and four female students divided into three dyads and one group of three students. The average age of the participants was 34 years (SD=11, range=22-51). The participants indicated that they had little to no experience with CSCL in their educational career. Data of various kinds and from multiple sources were used to promote the reliability of the findings. First, we used direct measures to investigate the collaboration and interaction processes: (a) all activities related to the production of the shared document were logged through the revision history, and (b) to capture students' interaction, chat logs, e-mail traffic, and comments in the shared document were collected. Second, students were interviewed three times during the DBR project. For this study, a part of the second interview was used, which was conducted after the completion of the CSCL task. In particular, this study focused on the part of the interview protocol centered on three main themes: participants' perceptions about (1) the collaboration process, (2) the planning and self-assessment tools, and (3) students' interaction. The average duration of the second interview was 22:02 minutes (SD=05:27, range=15:24-31:42). In order to guard the validity of this study, the interviewer ensured that all participants felt comfortable and secure to talk freely during the interview.

3.3 Data analysis

3.3.1 Revision history

A coding scheme was developed to analyze the contributions to the shared document. We further elaborated on (a) the coding scheme of Peters and Slotta (2010) for analyzing contributions in a wiki, and (b) the research of Onrubia and Engel (2009, 2012) who identified several strategies for the collaborative elaboration of written products. The unit of analysis for studying the revision history was defined as a transaction (e.g. add text, delete text, or move text). For each unit of analysis (transaction) three variables were coded: (1) participant (i.e. who performed the transaction), (2) content (i.e. prior knowledge, planning, step 1-7 of the template, or self-assessment), and (3) transaction type (i.e. move text, add text, delete text, format text, spelling correct, or insert a comment). When the transaction type was the same (e.g. adding text in step 2), but the student moved over to a next section in the document (e.g. adding text in step 3), this was coded as two individual transactions, i.e. two different units. Next, the coded data was analyzed at group level and represented in such way that it became clear how the group (a) coordinated their group work, and (b) used the planning and self-

assessment tools. All groups made use of the shared document to complete their task, except for group 3. For this group we cannot rely on the revision history to explore their collaboration process.

3.3.2 Interaction

Three groups (G1, G2, G4) used Facebook messenger to interact with each other, while group 1 also used the chat function, and group 2 also used the comment function in the shared document. Group 3 only interacted with each other via email. All interaction was logged, except for the chat function in the shared document, because it was not possible to capture this data. With regard to the coding of the data, each separate message was identified as unit of analysis. Five descriptive codes were created based on a first reading of the data and previous research focusing on interaction between group members (i.e. Isohätälä, Järvenoja, & Järvelä 2017; Onrubia & Engel 2012; Strijbos et al, 2006): (1) task content, i.e. sharing content-related information, discussing content; (2) task coordination, i.e. organization and coordination of the group work; (3) non-task: social issues, i.e. social atmosphere, informal talks; (4) non-task: technical issues, i.e. the use of technology; and (5) non-codable, i.e. units that cannot be assigned any other code.

3.3.3 Interviews

All interviews were audio-recorded with permission from the participants, and afterwards transcribed. The interview responses were analyzed using NVivo 11. First, the first author read and reread the interview transcripts in order to become familiar with the data. Second, a coding scheme was elaborated based on the research questions and theoretical framework. This resulted in seven codes: students' perceptions about the (1) group coordination, (2) collaboration, (3) distribution of the work load, (4) roles of the group members, (5) interaction about the task, and the use and usefulness of (6) the planning tool and (7) the self-assessment tool. Third, the two coders independently analyzed all interview transcripts, and compiled a framework matrix (Miles & Huberman 1994) by listing the participants in rows and the codes in columns. In order to illustrate the findings, the results section frequently draws on participants' quotes. These quotes were translated from Dutch to English. Each participant's name was replaced by a code of which the number indicates the group number, and the letter corresponds to the individual student.

3.3.4 Interrater reliability

Two independent coders carried out all the coding activities to check the reliability of the results. First, based on the revision history and students' individual interviews, a group work coordination approach could be assigned to each group. The two coders independently assigned a group work coordination approach to the four groups, and percent agreement between both analyses was 100% (4 out of 4 cases). Second, the reliability of coding the students' interaction was checked by calculating the Cohen's kappa value after the two independent coders had coded all 84 messages. There was substantial agreement between the two raters' judgements ($\kappa = .76$) (Landis & Koch 1977). Afterwards, all disparities were discussed by the two independent coders until agreement was reached on all codes. Third, based on the interview transcripts, a systematic summarizing report was written for each individual student, presenting the analysis for each participant in a structured form. The two coders independently conducted each analysis and the interpretations were discussed and refined until consensus was reached. Afterwards, a framework matrix (see 3.3.3 Interviews) was compiled to provide an overview of the results.

4. Results

4.1 Group 1

Figure 1 provides an illustration of (1) which student added, formatted, or deleted text in a certain step in the document, and (2) the sequence of the individual transactions (also indicating turntakes). It is clear that the contributions of both team members were not equally distributed. The direct measures showed that

participant 1B did most of the work on his own, while participant 1A contributed the least to the document. Both participants also indicated in the interview that participant 1B did most of the work. However, participant 1B reported that they agreed that he did most of the work at his own, while participant 1A stated that they decided together which information was or was not important and should be included in the document. We identified this form of organizing group work as *chain coordination* (Onrubia & Engel 2009, 2012): participant 1B contributed a complete solution for the task, while participant 1A successively added his contributions to this initial document.

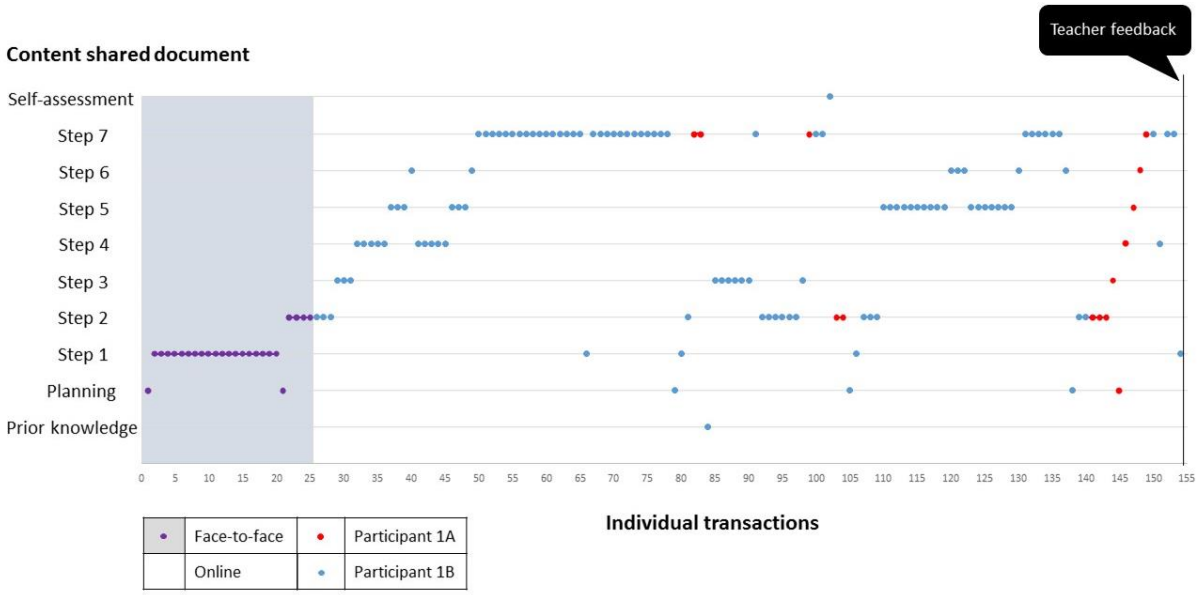

Figure 1: Visualization of the revision history for group 1

Group 1 did not complete the planning tool in advance, but afterwards, when they were actually working on the task. Participant 1A stated that it was difficult to estimate beforehand when he had time to work on the task. Both group members did not think the planning tool was useful. With regard to the self-assessment tool, participant 1B completed this self-assessment tool after execution of the largest part of the task. All items were scored agree or totally agree, except for two items that were scored more or less agree. However, no specific adjustments were made based on this evaluation, and no new self-assessment was made after further revision of the document. Both group members indicated that they made no or minimal revisions based on the self-assessment. Participant 1B indicated "Is it *[the self-assessment tool]* useful or not, I don't know. You always think that you did it well, or as good as possible." In addition, the group made no adjustments based on the feedback of the teacher.

The group members interacted with each other through Facebook messenger and the chat in the shared document. Eight separate messages were sent through Facebook messenger. Seven messages were sent to coordinate the group work, such as "I am working on our task", and one message contained information about the content of the task.

4.2 Group 2

Figure 2 shows the same information for group 2. It is clear that this group divided the work among the group members and every student had his or her own part of the task for which he or she was responsible. Next to this, the group members made use of the comment function in the shared google document to ask for and give feedback to each other. In line with these direct observations, all group members indicated during the interview that they completed their individual part, and provided feedback and extra information. We identified this form of organizing the group work as *jigsaw coordination* (Onrubia & Engel 2009, 2012): the

group decided to share out different parts of the task. However, in this specific case, students also used the comment function to request and provide peer feedback.

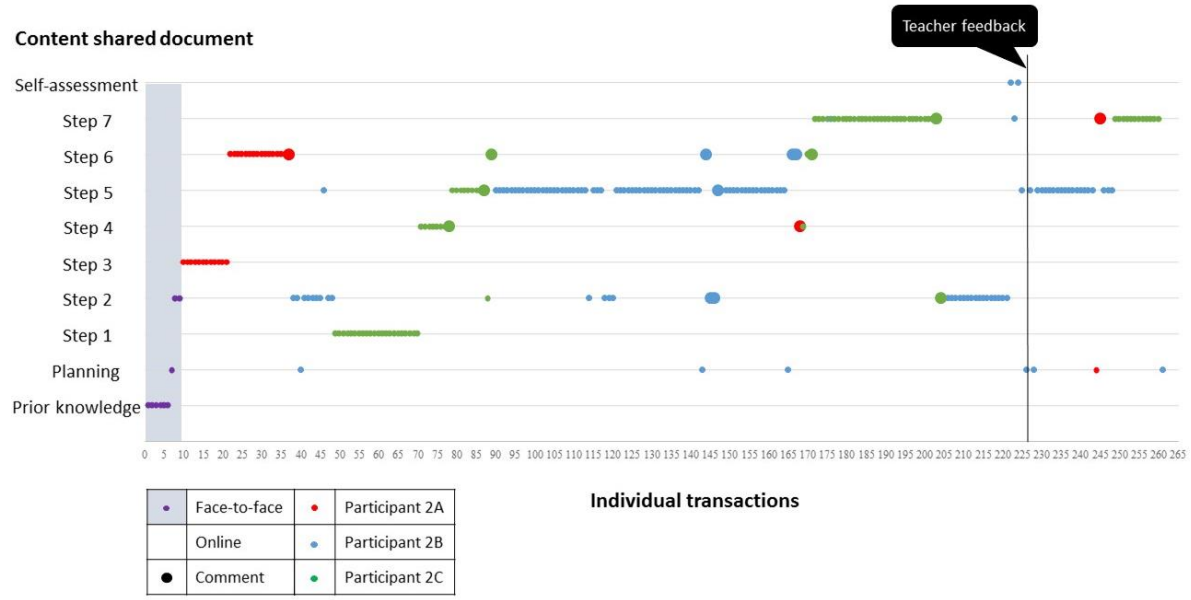

Figure 2: Visualization of the revision history for group 2

The planning tool was completed during the face-to-face meeting, i.e. before starting the task, and further adjusted during the task. The three participants indicated that the planning tool was useful to regulate themselves (i.e. setting clear deadlines), and to regulate the others (i.e. assess if the other group members are respecting the deadlines and remind them of the deadlines when needed). With regard to the self-assessment tool, participant 2B assessed the group's pre-final product. However, the subsequent adjustments were mainly based on the feedback of the teacher. At the moment of the interview, the self-assessment tool was not yet completed, which made that we have no data about the usefulness of the tool.

The group members interacted through Facebook messenger and comments in the shared document. First, 48 messages were sent through messenger. These messages contained mainly information related to task coordination (n=34), e.g. "I finally found the time to complete my part", some information related to the task content, especially to share information (n=7), some informal talk (n=6), and one non-codable message. Second, 21 comments were added in the Google document. These messages contained 13 content-related messages (e.g. I found this source when I was looking for information, maybe you can use it), five task coordination messages (e.g. later on, we can discuss this together), 2 messages concerning technical issues (e.g. how can I delete the grey box behind my text?) and 1 message that was non-codable. Participant 2C summarized: "it is not that we discussed or negotiated about the content, but rather that someone asked to check something or to provide feedback."

4.3 Group 3

To identify the group work coordination strategy of group 3, we could only rely on the interviews with both group members. Both students reported that participant 3A started with the task and completed most of the steps, while participant 3B was not tackling the task. However, when participant 3B noticed that participant 3A did all the work, she did not agree with that and came into action. In particular, participant 3B also completed the whole task individually, and then both participants came physically together to select the most important information based on their individual preparations. This form of organizing the group work was identified as

star coordination (Onrubia & Engel 2009, 2012): both students first made an individual preparation, and composed together the final document.

With regard to the planning tool, both participants recognized that they did not plan their work in advance. Moreover, the participants indicated that they did not exactly discuss how they were going to tackle the task exactly. In this respect, student 3B stated: "we agreed that we would work on the task when we had time, and we would meet each other afterwards." In addition, despite both group members stated that they thought it was useful to complete the self-assessment tool, student 3B indicated: "we scored all items positive because we worked well on the task" and "we made no adjustments to our work based on the self-assessment tool". In addition, the group made no adjustments based on the feedback of the teacher.

The group members interacted with each other via e-mail. Five e-mails were sent, all with information related to task coordination, i.e. to meet each other face-to-face, and to discuss how they would further approach the task.

4.4 Group 4

Figure 3 provides an illustration for group 4. Both group members first worked together on step 1 during the face-to-face moment. During the subsequent days, student 4A completed the first five steps. One week after the face-to-face moment, both students came physically together to work on the task. During this moment, they completed all 7 steps. Finally, student 4B completed the final and seventh step. This form of organizing the group work had close resemblance to the *chain coordination* (Onrubia & Engel 2009, 2012): student 4A contributed a partial solution of the task, later on both students made revisions to this solution, and finally student 4B completed the last part of the task.

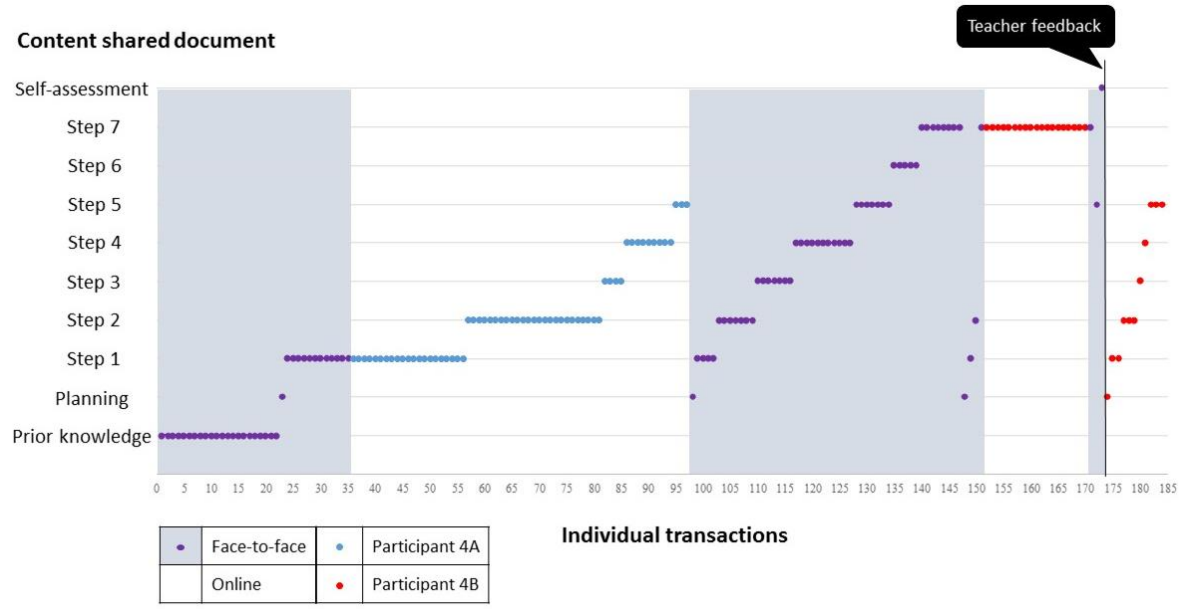

Figure 3: Visualization of the revision history for group 4

With respect to the use of the planning tool, the group did not plan their work in advance. However, they decided to meet each other face-to-face to work together on the task. Both participants indicated that they did not exactly discuss how they were going to tackle the task. As such, student 4A started with the task and tackled most of the steps. When student 4B noticed this, she asked her fellow student to wait for her since she also wanted to contribute equally on the document. In summary, the decision to work in this way, was not made in advance. Student 4A recognized that they did not use the planning tool in the way it was intended,

while student 4B indicated that the planning tool was useful to plan a date to meet each other. Finally, with respect to the use of the self-assessment tool, they completed this together after execution of the task. The changes student 4B made after completing the self-assessment, were mainly based on the teacher's feedback and not on the results of the self-assessment tool. At the moment of the interview, the self-assessment tool was not yet completed, which made that we have no data about the usefulness of the tool.

The group members interacted with each other through Facebook messenger. Two separate messages were sent, with information related to task coordination, such as "I went to the library during my break and found two good books."

5. Discussion

First, the results of this study show that the four groups used different group work coordination strategies to collaborate on a shared document. These strategies are in line with the approaches found in previous research (Onrubia & Engel 2009, 2012). A remarkable finding is that three out of the four groups did not decide upon a specific strategy to tackle the task in advance, despite the groups were stimulated to plan their work in the introductory face-to-face meeting by implementing a planning tool. Similar results were found in a study of Malmberg et al (2015), where mainly low performing groups failed in their regulation of the group work, despite the implementation of a tool to prompt students to plan their collaboration. Moreover, the self-assessment tool did not seem to stimulate the groups to reflect on their task and to reach consensus about the final product. Most of the participants did not recognize the value of carefully planning or assessing their work. A possible explanation for these rather disappointing results, might be that the students in this study had little or no experience with (online) collaborative tasks during their educational career. Since our study is solely based on one collaborative task, more practice moments for students could lead to other and maybe better collaboration approaches. In this respect, we believe that instructors should assist their students to improve their collaborative skills. With regard to instructional support, two things can be done: (a) providing more detailed tools or scripts to help students to regulate their group work, e.g. divide the steps among the students and work with a rotational system (e.g. De Wever et al, 2015), or provide a rubric instead of a checklist, and (b) offering more teacher guidance while students are planning and assessing their work, e.g. providing feedback on their collaboration process.

Second, it was found that online interaction about the task was rather scarce. Although the task was announced as a distance task, and despite the fact that the students could choose their own communication channel, two groups preferred to meet each other face-to-face to work on the shared document. From these two latter groups, we cannot make any claims about their interaction during the face-to-face moments. For the two other groups, it was remarkable that the group with the jigsaw approach discussed more (content-related) issues than the group with the chain approach. This finding is contrary to that of Mayordomo and Onrubia (2015), who found that the chain approach promotes more reciprocity than the jigsaw approach. A possible explanation for this might be that the different categories are rather broadly defined, leaving room for some variance on the approaches. For example, in our study, the group with the jigsaw approach also provided each other with feedback, and in the group with the chain approach one student contributed a complete solution for the task, while the other group member only edited small things. This finding raises the question whether students feel uncomfortable to interact about the task through online media (Malmberg et al, 2015) and prefer to meet each other face-to-face to collaborate on a shared document, or students may feel more inclined to interact with each other when the teacher provides a medium and obliges them to use it to complete the task. Further research should be undertaken to investigate the opportunities of other tools and ways to stimulate and ensure interaction between group members.

The present study was limited to nine students working together in four groups on one specific task. Although this allowed us to conduct an exploratory study in a detailed way, taking into account the specific authentic

context in which CSCL was organized, replication studies in other contexts may help us to deepen our understanding. However, this study provides interesting insights of process-oriented research in an authentic context.

In the present study, a rationale for the learning design is outlined, and the paper explores the lessons learnt from students' collaboration processes in, and experiences with, CSCL. Our results hold both theoretical as well as methodological implications. On the theoretical level, further research is necessary regarding the search for optimal instructional support for students with a degree of vocational and technical secondary education to enhance the collaboration and interaction processes in CSCL. Future research might consider more structured guidance to help students to regulate their group work, and should focus on ways to stimulate students to interact with each other during online collaboration, and especially to exchange content-related information. On the methodological level, the revision history of the shared document was a reliable data source to observe and analyze how each group member contributed to the document, and to identify how groups coordinated their group work. As such, this is a useful tool for both researchers and instructors to investigate students' collaboration processes.

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References

Barnard, L., Lan, W. Y., To, Y. M., Paton, V. O. and Lai, S.-L. (2009) "Measuring self-regulation in online and blended learning environments", *The Internet and Higher Education,* Vol 12, No. 1, pp 1–6.

De Wever, B., Hämäläinen, R., Voet, M. and Gielen, M. (2015) "A wiki task for first-year university students: The effect of scripting students' collaboration", *The Internet and Higher Education*, Vol 25, pp 37–44.

Hämäläinen, R. and De Wever, B. (2013) "Vocational education approach: New TEL settings—new prospects for teachers' instructional activities?", *International Journal of Computer-Supported Collaborative Learning*, Vol 8, No. 3, pp 271–291.

Isohätälä, J., Järvenoja, H., and Järvelä, S. (2017). "Socially shared regulation of learning and participation in social interaction in collaborative learning", *International Journal of Educational Research*, Vol 81, pp 11–24.

Järvelä, S., Kirschner, P. A., Panadero, E., Malmberg, J., Phielix, C., Jaspers, J., Koivuniemi, M. and Järvenoja, H. (2015) "Enhancing socially shared regulation in collaborative learning groups: designing for CSCL regulation tools", *Educational Technology Research and Development*, Vol 63, No. 1, pp 125–142.

Landis, J. R., and Koch, G. G. (1977). "The Measurement of Observer Agreement for Categorical Data", *International Biometric Society*, Vol 33, No. 1, pp 159–174.

Makos, A., Lee, K. and Zingaro, D. (2015) "Examining the characteristics of student postings that are liked and linked in a CSCL environment", *British Journal of Educational Technology*, Vol 46, No. 6, pp 1281–1294.

Malmberg, J., Järvelä, S., Järvenoja, H. and Panadero, E. (2015) "Promoting socially shared regulation of learning in CSCL: Progress of socially shared regulation among high- and low-performing groups", *Computers in Human Behavior,* Vol 52, pp 562–572.

Mayordomo, R. M. and Onrubia, J. (2015) "Work coordination and collaborative knowledge construction in a small group collaborative virtual task", *The Internet and Higher Education*, Vol 25, pp 96–104.

McKenney, S. and Reeves, T. C. (2012) *Conducting Educational Design Research*, Routledge, London.

Miles, M. B. and Huberman, M. A. (1994) *Qualitative data analysis: An expanded sourcebook (2nd ed.),* Sage, London.

Onrubia, J. and Engel, A. (2009) "Strategies for collaborative writing and phases of knowledge construction in CSCL environments", *Computers & Education*, Vol 53, No. 4, pp 1256–1265.

Onrubia, J. and Engel, A. (2012) "The role of teacher assistance on the effects of a macro-script in collaborative writing tasks", *International Journal of Computer-Supported Collaborative Learning*, Vol 7, No. 1, pp 161–186.

Panadero, E., Järvelä, S., Malmberg, J., Koivuniemi, M., Phielix, C., Jaspers, J. and Kirschner, P. (2013) "Enhancing socially shared regulation in working groups using a CSCL regulation tools", *AIED Workshops*, pp. 7–12, http://ceur-ws.org/Vol-1009/1002.pdf.

Peters, V. L. and Slotta, J. D. (2010) "Analyzing Collaborative Knowledge Construction in Secondary School

Biology", Paper presented at the International Conference of the Learning Sciences, Chicago, June-July.
Räisänen, M., Postareff, L. and Lindblom-Ylänne, S. (2016) "University students' self- and co-regulation of learning and processes of understanding: A person-oriented approach", *Learning and Individual Differences*, Vol 47, pp 281–288.
Schwendimann, B. A., De Wever, B., Hämäläinen, R., and Cattaneo, A. A. P. (2017). "CSCL and Vocational Education: A Bond Worthy of Investigation?" In B. K. Smith, M. Borge, E. Mercier, and K. Y. Lim (Eds.), Making a Difference: Prioritizing Equity and Access in CSCL, 12th International Conference on Computer Supported Collaborative Learning (CSCL) 2017 (pp 557–560). Philadelphia: International Society of the Learning Sciences. Retrieved from https://repository.isls.org/handle/1/282
Stahl, G. (2005) "Group cognition in computer assisted collaborative learning", *Journal of Computer Assisted Learning*, Vol 21, pp 79–90.
Strijbos, J. W., Martens, R. L., Prins, F. J., and Jochems, W. M. G. (2006). "Content analysis: What are they talking about?", *Computers and Education*, Vol 46, No. 1, pp 29–48.
Zimmerman, B. J. (2002) "Becoming a Self-Regulated Learner: An Overview", *Theory Into Practice*, Vol 41, pp 64–70.