

The role of teacher assistance on the effects of a macro-script in collaborative writing tasks

Javier Onrubia · Anna Engel

Received: 28 September 2010 / Accepted: 20 June 2011

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Abstract Some recent proposals on CSCL scripts have suggested that one key factor for their effectiveness is the ability of the teacher to adapt the scripts to the students and to the specific teaching and learning situations. In this context, this paper presents a multiple-case study dealing with the relationship between the assistance given by the teacher during the collaborative process and the forms of collaborative work developed by groups of university students in two natural settings, in which two different types of macro-script are used. Specifically, the study sets itself three objectives: (1) to identify patterns of teacher assistance to the collaborative work developed by the groups; (2) to identify the forms of collaborative work developed by the groups; and (3) to explore the relationships between the patterns of teacher assistance, the forms of collaborative work and the level of performance achieved by the groups. The results show two different patterns of teacher assistance in the two settings. These patterns differ on four dimensions: the aspect of the task on which the teacher was offering assistance, the moment in which the assistance was offered, the recipient of the assistance, and whether the assistance offered by the teacher was spontaneous or requested by the students. These patterns are related with the forms of collaborative work developed by the groups (how the group is organized and how the written work is produced) within the structural framework imposed, in each setting, by the macro-script.

Keywords CSCL scripts · Higher education · Patterns of group organisation · Phases of collaborative knowledge construction · Teacher assistance

J. Onrubia (✉) · A. Engel

Department of Developmental and Educational Psychology, University of Barcelona,
Passeig de la Vall d'Hebron, 171, 08035 Barcelona, Spain
e-mail: javier.onrubia@ub.edu

A. Engel

e-mail: anna.engel@ub.edu

Introduction

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One of the biggest challenges in the field of CSCL is to design settings to promote ways of organizing joint activity between students to enable them to build knowledge—‘new’ knowledge, knowledge that neither student had prior to the collaboration—that it would be difficult for them to achieve acting individually. According to Stahl (2005), the cornerstone of collaborative learning is the power of the group as a whole to promote the individual learning of each of its members.

In any collaborative learning situation whether face-to-face or online, it is not enough for the participants simply to share their opinions or knowledge about the teaching and learning content or tasks; they need to be involved in forms of talk that will enable them to develop higher and higher levels of intersubjectivity so that they can progressively extend and enrich the meaning systems that they jointly build (Stahl 2005; Suthers 2006). These forms of talk include the exploratory conversation (Barnes 1976; Mercer 1995, 2000), dialogic inquiry (Wells 1999) and progressive discourse (Bereiter 1994; Scardamalia and Bereiter 1994, 2003). The students also need to coordinate and regulate the activities related to the task, as well as coordinate and regulate their participation in the technological environment. They need to coordinate the use of fonts and resources, for example, decide on a common course of action, supervise task progress (Erkens et al. 2005; Forman and Cazden 1985; Manlove et al. 2009; Meier et al. 2007) and take on interdependent and complementary roles (Blaye and Light 1990; De Wever et al. 2009; Tharp et al. 2000; Strijbos et al. 2005).

However, research into CSCL has repeatedly found that this type of collaboration, which is ideal for learning, does not come about spontaneously in computer-mediated situations no matter how sophisticated the available technological resources and devices may be (Arvaja et al. 2003; Järvelä and Häkkinen 2002; Kirschner et al. 2008; Kobbe et al. 2007; Lipponen 2002; Rourke and Kanuka 2007; Weinberger et al. 2005).

The evidence that CSCL scenarios do not necessarily mean that an efficient collaborative work process will be developed or that the achievement of better learning results is guaranteed has led part of the current CSCL debate to focus on the various ways in which to structure and guide the students’ collaborative processes to facilitate them developing the best possible interactions from the point of view of collaborative knowledge construction. In this context a number of authors have suggested that predefined collaboration scripts should be designed into the CSCL scenarios as an instructional approach to support collaborative learning (for full details on this subject see Fischer et al. 2007).

According to Dillenbourg (2002, p. 1), “a collaboration script is a set of instructions prescribing how students should form groups and how they should interact and collaborate in order to solve a problem”, and is used to induce the emergence of specific knowledge-productive interactions and mutual regulation. In this respect scripts are related to different outlines or patterns of design with regard to the type of interpsychological mechanisms—the core mechanisms—which, by promoting or limiting certain interactive communication dynamics between them, it is hoped the students will activate.

Scripts can vary as regards the granularity of the actions prescribed. In this respect, Dillenbourg and Hong (2008) distinguish between micro-scripts and finer-grained scripts, which provide detailed guidance on specific activities—usually dialogue or argumentation models or the design of the communication interface—which students are expected to adopt and progressively internalize (Scardamalia and Bereiter 1994; Suthers and Hundhausen 2001; Weinberger et al. 2005); and macro-scripts, pedagogical scenarios or models which typically set the conditions for collaborative learning prior to the collaboration stage

(Dillenbourg and Jermann 2006). Certainly, the scripts always involve disturbing “natural” group dynamics to some extent. Fixing these degrees of coercion (a fixed or open time limit for activities, the degree of detail included in setting guidelines for the tasks or subtasks, whether students are assigned particular roles or not, etc.) is a delicate design choice (Dillenbourg 2002). Scripts can also vary in their orientations. Several authors distinguish between content-oriented or epistemic scripts, aimed at facilitating the cognitive processes of collaborative learning by providing problem-solving strategies, and process-oriented or social scripts, aimed at providing guidance as to how students should interact efficiently and responsibly with the other members of the group (De Wever et al. 2007; Schellens et al. 2005; Strijbos et al. 2004; Strijbos et al. 2007; Weinberger 2003). Hence, for example, a checklist would illustrate the idea of an epistemic script in so far as it helps learners to consider all relevant aspects of the learning task in a suitable order and work more productively. The scientific peer review process, on the other hand, would illustrate the idea of a social script that helps collaborators take on the role of critics and look for the flaws in a proposal (Weinberger 2003).

Many studies have concluded that a certain amount of structuring can promote the collaborative learning processes by guiding the actions of the participants (i.e., De Wever et al. 2007; Dillenbourg and Jermann 2006; Hämmäläinen and Häkkinen 2010; Kirschner et al. 2008; Rummel and Spada 2005; Slof et al. 2010; Stegmann et al. 2007). However, as Dillenbourg and Tchounikine (2007) point out, these studies do not prove that scripts are always effective. On the contrary, they show that scripts’ effects are “fragile”—scripts may be effective under some circumstances and not effective under different circumstances. In their analysis of the factors that may explain these results, the same authors note that the fragility of the scripts’ effects is not only to do with their intrinsic quality but, to a great extent, with the ability of the teacher to adapt the script to the students and to the specific teaching and learning situation. They point out that the way in which teachers adapt the script to their context is a key variable to be explored in future papers.

So far the role of the teacher in script-assisted teaching has not been studied in much detail. There are, however, a good number of papers that report that the teacher plays an important role in virtual learning environments. Examination of these papers provides elements of definite interest for analysing the impact that teacher assistance has on collaborative learning (see for example Berge 1995; Mason 1991; Paulsen 1995). These papers that focus on the teacher as facilitator or moderator have typically analyzed online discussion groups. However, we can see that there is a need to extend this research to other types of activity that also frequently occur in CSCL, such as those aimed at producing written work.

In this context, this study deals with the relationship between the assistance given by the teacher during the collaborative process and the forms of collaborative work developed by groups of university students in tasks in which they need to produce pieces of written work following macro-script guidelines. To this end, a multiple-case study is carried out in two natural instructional settings, in which two different types of macro-script are used. The settings have a duration of 17 and 13 weeks respectively, thereby enabling a study of how the participants’ actions evolve. Specifically, the study sets itself three objectives: (1) to identify patterns of teacher assistance to the collaborative work developed by the various groups; (2) to identify the forms of collaborative work developed by the various groups (how the group is organized and how the written work is produced); and (3) to explore the relationships between the patterns of teacher assistance, the forms of collaborative work and the level of performance achieved by the groups within the structural framework imposed, in each case, by the macro-script.

Method

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Participants and situations observed

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The work was carried out using an observational approach in a natural context and is a multiple case study. Four didactic sequences (DS)¹ based on online collaborative activities with university students were observed and analyzed. The four DSs studied correspond to two different teaching and learning settings that take place at two different institutions using different virtual platforms. In each of the two settings, two consecutive didactic sequences were observed. All four DSs were designed and developed by the teachers without interference from the researchers. Each DS constitutes a case in our study.

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Various revisions of the methodology of investigation in CSCL (see for example, Schrire 2006; Stahl et al. 2006) point out case studies as an appropriate strategy for the analysis and interpretation of the interactions between the participants in CSCL environments. Multiple-case studies are one of the forms that this strategy can adopt (Yin 2003). Although the cases studied cannot be absolutely identical, this type of study enables real instructional contexts to be analyzed, thereby increasing the robustness of the conclusions obtained, and this is especially useful when the cases show complementary results that can be linked to predictable conceptual reasons. The aim of this type of study is not to make a statistical comparison of the results and apply them to other groups, but to check certain conceptually established propositions and dimensions in various contexts (Yin 2003). In our work, we want to check whether the combination of particular macro-scripts with particular patterns of teacher assistance seems to be associated with particular ways of working and learning for small groups of university students who collaborate to produce pieces of written work. As a result, the analysis is focused on exploring the various cases to see if this association comes about, and how. The codification and frequency count of the types of assistance provided by each teacher are used as instruments to help identify the patterns of assistance for each of them based on the combination of the forms of assistance used, not to carry out a statistical comparison. Moreover, the study is planned as an essentially exploratory paper, the results of which will need to be confirmed in later papers, in both natural and experimentally controlled situations.

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The observed settings were chosen following intentional or theoretical sample criteria. The four DSs studied were of the same level academically (undergraduate students) and had the same general content (an introductory course on "Educational Psychology"). They were based around students working collaboratively in small groups to produce written work, they enabled these processes to be observed for a relatively long and uninterrupted time, and they were carried out via virtual learning environments which had some of the tools typically used for supporting and developing collaborative learning processes (general work spaces for the group-class, spaces for small group discussions, the possibility of exchanging files, tools for communication between teacher and students and between the students themselves). The teachers belonged to different institutions and had planned to use different teaching methods: one of them, to give general instructions basically concentrating on the steps to be followed to carry out the task; and the other, to give highly detailed guidelines regarding how to organize and distribute the work. In addition to this, the teachers and

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¹ A didactic sequence (DS) is defined as a process that includes all the typical components of a teaching and learning process -goals, content, teaching/learning activities and assessment activities- in which it is possible to identify a beginning, a development and an end.

students in all cases were willing to allow us full access to the natural work processes and help us in gathering data.

Setting 1

The first setting observed was for practical credits for the Psychology of Education course, part of the curriculum for the Bachelor of Arts degree (BA) in psychology at the University of Barcelona. The participants were the teacher and 11 students. The teacher had a great deal of experience in teaching educational psychology to undergraduate students, but had no previous experience as a teacher in virtual environments. Some of the students already knew each other and shared other subjects taught face-to-face, while others did not. Only three of them had previously taken part in an online course. All the students taking part were asked to carry out all the interaction related to the observed instructional processes via the virtual platforms and to avoid any interaction in this area face-to-face, by telephone or any other online medium (private e-mail, instant messenger, social networks...). All the students fulfilled several self-reports along the course and reported that they had complied with this request. For the course, the students were organized in three groups of three, three and five members. The composition of the groups was decided by the students. All three groups and the teacher were analyzed.

All the tasks designed for the course's practical credits revolved around the analysis of a case of intervention by a school psychologist. In this case, the psychologist had to help a mathematics teacher to improve certain aspects of his performance, based on the analysis of a video recording of one of his classes. The groups' analysis and resolution of the case was structured in two main stages that made up each of the two DSs recorded and analyzed: an initial general approach to the case, based on the students' previous knowledge, and afterwards a more analytical and systematic approach, guided by the theoretical content of the course. Their duration was of five and 12 weeks respectively. In each stage the groups of students had to carry out a series of tasks of various types which were directed by the

Table 1 Tasks given to students in the didactic sequences (Setting 1)

Task	Individual/Group	Nature of the task
DS1	Individual	Observation of the situation subject of the intervention
Task 1.1	Group	Initial diagnosis of the situation observed
Task 1.2	Group	Check against psychologist's diagnosis of the case, review and improvement of initial diagnosis
Task 1.3	Group	Reflective summary of the work carried out
DS2	Individual	Theoretical review of learning strategies
Task 2.1	Group	Diagnosis of the situation observed from the point of view of learning strategies
Task 2.2	Group	Check against psychologist's diagnosis of the case, review and improvement of diagnosis
Task 2.3	Group	Theoretical review of motivational aspects
Task 2.4	Group	Diagnosis of the situation observed from the point of view of motivational aspects
Task 2.5	Group	Check against psychologist's diagnosis of the case, review and improvement of diagnosis
Task 2.5	Group	Final summary

teacher. The basic features of these tasks are shown in Table 1. At the end of each task, the students had to hand in a piece of written work. Once the whole process was finished, the teacher sent a quantitative grade to each small group.

The path formed by the two stages and their various tasks acts as a case script for the students and supplies a strategy for resolving the case, regulating the sequence of activities that need to be carried out to deal with it. In both DSs, this sequence involves making an initial diagnosis or assessment of the class observed, checking this diagnosis against the one made by the psychologist involved in the case, reviewing the initial diagnosis and analysing the entire process followed. In addition to this, in the second stage the work was carried out by focusing successively on two types of key factors –cognitive and affective/relational– that appear in the class observed, preceded by a systematic review of theory on these factors. This case script, therefore, focuses basically on structuring the content that students have to discuss in order to produce the written resolution of the case. To this end, it guides the tasks to be carried out by the students and the sequence in which they should be dealt with. However, it leaves open those aspects related to how the group's work should be structured as regards organization and coordination; in this framework, the students had to develop and establish their own strategies and dynamics for group work and take their own decisions regarding the use of the communication resources available.

The sequences took place via a Moodle platform. The students had a main virtual classroom (which all the students and the teacher could access) and a private classroom for each group's collaborative work (which only the group members and the teacher could access). In the main classroom, the students had access to general information about the practical credits and to the materials and the specific case information. The classroom also had a work calendar for each phase of the case, a notice board; specific spaces for the teacher's publication of the task directives and for the submission of the written works to the teacher, as well as an open forum for public communication between the teacher and the entire class. The students, on the other hand, had private spaces for the collaborative work in small groups. In these spaces, the students could engage in synchronous communication through a chat, and asynchronous communication, through a forum with the possibility of exchanging archives.

The environment was new for the students, who had not used it previously.

Setting 2

The second setting involved two modules of a Psychology of Education course, part of the curriculum of the BA in Psychopedagogy at the Universitat Oberta de Catalunya (Open University of Catalonia). These modules were recorded and analyzed. Participating in the sequences were the teacher and 35 students. As in Setting 1, the teacher had a great deal of experience in teaching educational psychology, but had no previous experience as a teacher in virtual environments. Only two students had previously taken part in online courses. The students had attended a face-to-face meeting before the start of the course. All the students taking part were asked to carry out all the interactions related to the observed instructional processes via the virtual platform and to avoid any interaction in this area face-to-face, by telephone or any other online medium (private e-mail, instant messenger, social networks...). All the students fulfilled several self-reports along the course and

reported that they had complied with this request. On the course, the students were organized into eight small groups by the teacher. Three of these groups (a total of 12 students, four in each group) were analyzed in the study.

The course was divided into three modules. The DSs studied correspond to Modules 2 and 3 of the course. The duration of the sequences was of 6 and 7 weeks respectively. In each sequence the students had to carry out one task individually and two tasks in small groups. In DS1 (Module 2) the group task consisted of analysing different educational situations using theories presented in the module and drawing up a conceptual map of the main concepts for one of those theories. In DS2 (Module 3) the task consisted of characterizing different developmental contexts (family, school, media, etc.) from particular theoretical aspects and analysing possible contradictions between two of these contexts (i.e. contradictions in the values transmitted by the school and the family, or the family and the media). At the end of each DS the teacher sent a report with a qualitative assessment to each small group.

For each group task, the teacher provided a very detailed set of instructions which divided the task up into smaller steps and indicated, for each step, what sub-task needed to be carried out, who should do it, what sort of document form it should be presented in, when it should be handed in, and what criteria would be used to assess it. Table 2 gives an example of this type of instructions for one of the task

As the example shows, these instructions act like a script, focusing basically on the assignment of roles and sub-tasks to each member of the group aiming to make the participation egalitarian and fair. The script structures the organization and internal distribution of the work to be carried out by the students, aiming to ensure a discussion process based on a “peer review” mechanism—an initial individual contribution from each member of the group, comments and mutual review of those contributions, and their subsequent integration into a joint final document that takes into account the mutual comments—. The script also instructs the groups to appoint someone to take on the role of leading the process of carrying out each task and conveying possible queries to the teacher. However, this peer review script leaves issues relating to the content of the tasks more open, along with how to use theoretical concepts to resolve them.

The work was carried on the University’s Virtual Campus. The virtual classroom of the course included several diverse spaces of communication: a notice board where only the teacher could post notes and upload text documents; a general forum where both the teacher and the students could participate; the group work space, a private work space for the members of each group with a forum, a zone for storage and interchange of files, and a board where the teacher could intervene if so desired; and the space for continuous evaluation, where the students send their written works to the teacher. The students could also use the electronic mailing system of the Virtual Campus, called personal mailbox for their communication concerning the course. The students were familiar with the environment, which they had used widely in previous subjects.

Data gathering procedure

The main body of data gathered comprised all the messages and documents exchanged among the participants –teacher and students– in the groups analyzed in the different available communication spaces throughout the entire duration of the two settings. Moreover, we gathered additional information that was used to provide the analysis with contextual elements and to facilitate the comprehension and interpretation of the messages and documents registered (interviews, questionnaires and self-reports). We also collected the grades given to each group by the teacher.

t2.1	Table 2 Instructions provided by the teacher for carrying out Task 2.1 (Setting 2)					
t2.2	Task	Who does it	How to do it	Document to hand in	Assessment criteria	Deadline
t2.3	1. Complete in a rough copy the tables that appear in the presentation of the activity, filling in all the boxes	Everyone individually	Each member of the group completes the table for the analysis of each educational practice (family, media, school, permanent education) along with the systems that characterize it.	Each person sends their task to the group space's file area: TEAM (number)-(letter)-Task1	Hand in the document by deadline. Identify the important information characterizing the educational practices based on the different aspects and systems applied.	23.11
t2.4	2. Integrate the tables completed by the different group members in the previous stage.	Person responsible	The person responsible draws up two tables that integrate and at the same time summarize the contributions from the different group members. The other group members approve it.	A document to the group space's file area with the completed tables. Identification: TEAM (number)-Task2	Hand in the document before deadline. Integrate all the answers.	25.11
t2.5	3. Write in a document, context to context, the way in which they are characterized, emphasizing the common elements and the differences.	Everyone individually	Each member of the group thoroughly details the type of information that characterizes an educational practice and the systems that distinguish it.	A document to the group space's file area. Identification: TEAM (number)-(letter)-Task3	Hand in the document by deadline. Gather the most relevant information to enable the educational practices and the systems that distinguish them to be characterized.	28.11
t2.6	4. Constructive comments on the work of another group member.	Everyone individually	The partner suggests where improvements could be made or, should the case arise, approves the work justifying why.	A document to the group space's file area. Please note: Task 4 is your partner's revised work in a different colour (which you were given in Activity 1).	Hand in the document by deadline. Comments with justifications for improvements (adding or deleting) as well as acknowledgements (left just as it is).	30.11
t2.7	5. Integrate all the tasks into a single document.	Person responsible	In order to make the revision easier for the person	A message to the group space's file area. Identification:	Hand in the document by deadline. Having collected all the	03.12

t2.8

Table 2 (continued)

Task	Who does it	How to do it	Document to hand in	Assessment criteria	Deadline
		responsible, include in only one document all the parts of the features and systems (with regard to the different educational practices) obtained in Task 4.	TEAM (number)-Task5	contributions and made a comprehensible presentation.	
6. Reflection on the value for the development of the different contexts.	Everyone at the same time.	The group members, while bearing in mind the features of the contexts, produce a reflection on the value of each for a person's development.	Send one document to the group space's file area. Identification: TEAM (number)-Task6	Contributions by deadline. Comments with justifications.	6.12

In Setting 1 a total of 617 messages, 61 chat sessions –lasting a total of 47 h 43 min– and 254 documents were gathered. In Setting 2 the total was 700 messages and 221 documents.

Data analysis procedure

In accordance with the objectives of the paper, the analysis aims to obtain information on three specific aspects:

- the various types of assistance offered by the teacher to the students throughout the DSs;
- the forms of organizing and coordinating the work adopted by the groups in the various tasks they carried out collaboratively;
- the forms of collaborative knowledge construction used by the groups to produce the end products for the different tasks they carried out collaboratively.

To this end a two-stage analysis procedure was followed. The first stage serves to identify the periods of activity in which the groups work collaboratively in each of the tasks posed by the teacher, and –when they do work collaboratively– the moments basically dedicated to organizing and coordinating the work, and those effectively dedicated to collaborative knowledge construction through the elaboration of the written products. Once these collaborative periods were identified, we proceeded with a finer analysis of the content of the participants' contributions, and to the more specific analysis of the ways in which the teacher assists, along with the forms of organization and coordination and collaborative knowledge construction used by the different groups in each of the tasks of the various DSs.

In order to analyze the ways in which the teacher assists, we identified all the teacher's contributions (messages and documents) that implied any kind of assistance for the students in carrying out the task and for completing the products required. The teacher's involvement in these contributions was described and categorized according to four dimensions (see Fig. 1):

- the aspect of the task on which he was offering assistance, distinguishing between assistance centred on the planning and organization of the small group work; assistance centred on the actual elaboration of the tasks, completing the end products and their content; assistance centred on course management; assistance centred on the use of technological resources, and assistance centred on the social atmosphere of the classroom. These distinctions were inspired by various papers on the role of the teacher in online environments (Berge 1995; Mason 1991; Paulsen 1995).
- the moment in which the assistance was offered, distinguishing between assistance offered before the groups started to work collaboratively to carry out each task, assistance offered in the course of this process, and assistance offered once the task was finished;
- the recipient of the assistance (the class group as a whole, a small group or an individual student); and
- the assistance offered by the teacher was spontaneous or requested by the students.

These categories were established as the result of a repeated process of back and forth between theory and data.

The codification unit used is the contribution ("post"). A contribution can contain various types of assistance, which means that a single contribution can be codified in various dimensions where necessary (e.g., an intervention could be "during the collaborative work process", "centred on the planning and organization of the small group work", "directed to the small group as a whole" and "requested by the students"). However, the categories for each dimension are exclusive, and therefore a contribution can only be

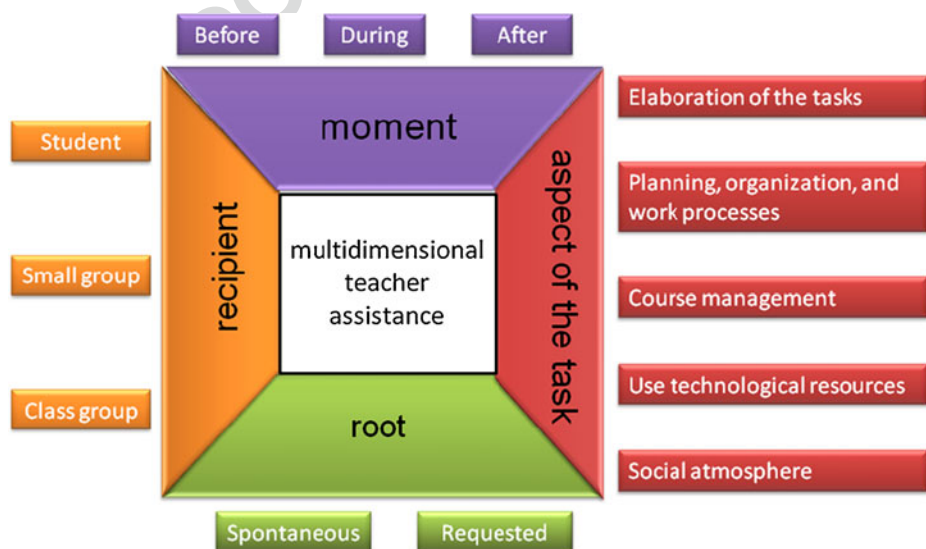


Fig. 1 Dimensions of teacher assistance

codified in a single category for each dimension. The initial task instruction documents, which include the respective macro-scripts, were not counted as assistance.

In order to identify both the forms of planning, organizing and coordinating the work and the forms of collaborative knowledge construction developed by the groups, an analysis was made of the chain of messages and documents exchanged by members of the group that had a direct bearing on the carrying-out of each task.

The forms used by the groups to plan, organize and coordinate the work were classified following the lines of a previous paper (Engel and Onrubia 2010) according to three broad categories entitled *jigsaw coordination*, *chain coordination* and *star coordination*. Each of these implies a different way of distributing roles and responsibilities among the members of the group, as well as a different way of coordinating each person's contributions and actions—who does what, when it needs to be done and how it relates to what the others are doing. Table 3 gives an operational description of each of these coordination categories.

The forms of collaborative knowledge elaboration were categorized following a model of collaborative construction phases that was also developed by us (Engel and Onrubia 2008; Onrubia and Engel 2009), inspired in this case by papers such as those by Gunawardena et al. (1997) and Garrison et al. (2001). The model distinguishes between four phases: the *initiation phase*, the *exploration phase*, the *negotiation phase* and the *co-construction phase*. These phases are described in Table 4. Ideally, these phases correspond to successive levels in the construction of a more widely shared, richer and more valid knowledge by the members of the small group. The phases are identified through the analysis of the process by which the written products are produced. Table 4 also shows the operational criteria that enable the phase achieved by a group on a particular task to be specified.

The general analysis procedures that we have just described are based on the model proposed by Coll and his colleagues for analysing joint activity in the classroom (Coll et al. 2008b; Colomina et al. 2001). This model has been used in various papers to analyze interaction processes in virtual contexts (i.e. Coll et al. 2008a) and to analyze CSCL processes in particular (Engel and Onrubia 2008).

A strategy of consensus among judges was systematically followed as a reliability check on the various sections of the analysis. In accordance with this strategy, two independent judges codified the entire corpus of data for each DS, confirming agreements and discussing disagreements, and based on the contrast we drew up finer-grained criteria for identification and categorization. In cases of persistent disagreement, a third judge was

Table 3 Categories used to identify the forms of organizing and coordinating the groups' work in the various tasks

"JIGSAW"	The students decide to share out different parts or different aspects of the activity and appoint someone to be in charge of integrating the individual contributions into a final document.
TASK COORDINATION	
"CHAIN"	One member of the group contributes a partial or complete possible solution to the activity; then this document is expanded and reviewed by the other members of the group in order to produce the final product for the activity.
TASK COORDINATION	
"STAR"	The students decide that they will all individually produce a full solution to the activity; then, based on these individual contributions, they will all compile a joint document.
TASK COORDINATION	

t4.1	Table 4 Categories used to identify the phases of collaborative knowledge construction achieved by the groups in compiling the end product for the various tasks	
t4.2	Category and description	Operational criteria—Indicators
t4.3	I. INITIATION PHASE. The group members make their ideas public, without questioning those presented by others. Nor do they get involved in explicit processes of negotiation of meanings, so that the joint activity gets more of a character of sum of monologues than a dialogue.	The end product compiled by the small group is a document created from the juxtaposition of different parts produced individually by different members of the group, each one without contributions from anyone else.
t4.4	II. EXPLORATION PHASE. The level of reciprocity and contingency between the members' contributions is higher than in the previous phase. In general, the responses to previous contributions are centred on completing or complementing the presented information with one's own information. The group members also tend to accept the previously presented information without questioning or criticizing. The participants' contributions reflect an accumulative construction based on acceptance with barely any critique, and mutual reinforcement of their ideas.	The end product compiled by the small group is:
t4.5		a) a draft document to which the members of the group have been adding cumulative contributions (without modifying content) from the various members of the group;
t4.6		b) a document written by one of the members of the group based on the juxtaposition of various individually written parts, after discussion and/or revision of these parts.
t4.7	III. NEGOTIATION PHASE. There is a presence of complex sequences of presentation, explanation, clarification, verification, reparation and confirmation of the presented meanings, and though to a lesser degree, of expression and discussion of disagreements between the participants. These sequences show that the students treat the ideas of others critically and constructively. Through this continuous and explicit process of negotiation, the participants establish and make progress in the process of shared meanings of the task, and the students' meanings get gradually richer and more complex.	The end product compiled by the small group is:
t4.8		a) a draft document to which the members of the group have been making contributions in which previously contributed content is modified, but without final revision of the document handed in;
t4.9		b) a document written by one student based on a joint discussion of the (total or partial) initial individual documents written previously by the members of the group, but without final revision of the document handed in.
t4.10	IV. CO-CONSTRUCTION PHASE. Before formally handing in the document to the teacher, the participants explicitly reach a consensus on the jointly constructed meanings, based on revision and approval of the document. This explicit revision and approval of the last version of the final document underlines and reinforces that the elaborated group product is genuinely shared and agreed upon.	The end product compiled by the small group is a document written as in Phase III, but which has also, in its final version, been revised or explicitly approved by the majority of group members.

used, who decided and established new criteria. The procedure was repeated until the two original judges' percentage of agreements was over 90% for the entire corpus of data.

Results

Assistance offered by the teacher

Table 5 shows the number of assistance interventions offered by the teacher, in each DS and setting, for each of the considered aspects of the task. Examples of the different

Table 5 Number of teacher interventions to provide assistance in different aspects of the task

	Organization	Elaboration	Technology	Management	Social	Total
Setting 1	6	29	28	117	43	223
Setting 2	16	13	7	42	22	100

interventions by the two teachers are presented in Table 6. Three of the results shown in Table 5 appear to be of special interest. First, a high percentage of teacher interventions relating to topics concerning the running of the course (deadlines, marks, announcements of document postings, etc.) were found in both settings. The percentage is particularly high in Setting 1 (117 out of a total of 223 teacher interventions). To a large extent this can be explained by the fact that, as a general classroom existed alongside the groups' private classrooms, the teacher often sent the same message regarding course management, for example, an announcement that he had posted a certain document or that a particular resource could be accessed to both the general classroom and the three private classrooms, thereby multiplying the number of messages. We also find, in both settings this time, a high percentage of teacher interventions (around 20%) aimed at creating a good classroom atmosphere. Second, Setting 1 has a higher percentage of interventions regarding technological questions. As mentioned earlier, the virtual environment used in this setting was new to the students, while Setting 2 involved a familiar environment, one with which they had experience. Third, and the most interesting from the point of view of our objectives, there is a difference between the two settings in terms of teacher interventions on questions relating not only to the organization and functioning of the groups, but also to the actual elaboration of the tasks, their content and the production of the corresponding piece of written work (see Table 5). Hence the teacher in Setting 1 mainly offers assistance related to the elaboration of the tasks, their content and the production of the corresponding piece of written work (29 interventions out of a total of 35), while the teacher in Setting 2 mainly offers assistance relating to the organization and functioning of the groups (16 out of a total of 29). These two areas of assistance are the ones most directly linked to the progress of the groups' collaborative work, and we will therefore focus on them from now on.

When interventions in these two areas are analyzed from the point of view of when the assistance is offered to the students, we find relevant differences between both settings (see Table 7; see also Table 6 for examples). The teacher in Setting 1 intervenes mainly before the students start working collaboratively on each of the tasks (22 interventions out of 35), and also once the tasks are finished (12 out of 35). Typically in pre-task interventions, the teacher sets the task, links it to what has been done previously, explains the sense of it and highlights basic aspects, and gives some pointers and recommendations as regards content in order to help the students carry it out. In later interventions, also typically, he gives some kind of feedback or comment on the work produced and the process followed. The teacher interventions in Setting 2, however, mainly occur during the students' work process (18 interventions out of 29). These interventions typically involve brief instructions to students as a reminder or to clarify or point out the guidelines already provided in the peer review script.

The two teachers' interventions to provide assistance in the two settings showed differences when the recipient of the assistance is considered, i.e. whether the assistance is directed towards the students as a whole, to the small groups or to individuals. The results in this case are shown in Table 8 (see also Table 6 for examples). It can be seen that the teacher interventions in Setting 1 are almost all directed to small groups (31 interventions

t6.1	Table 6 Examples of teacher's contributions [setting, #number of message, data, DS, communication space]	
t6.2	Aspect of the task on which he was offering assistance	
t6.3	planning, organization and work processes	I again stress the importance that, if at any time you share or distribute the work among yourselves, afterwards you need to have ways in which the work each person has done can be reviewed by the others or discussed with them, so that the final pieces of work are not simply a collection of pieces done by each person, but an authentic group product. [Setting 1, document linked to #98, 10.11, DS1, forum group 3]
t6.4		Each member of the group takes a situation that has to be resolved via the perspective of Piaget or Vygotsky. Afterwards you swap with a classmate and review each other's work. (My advice is that you should work in mixed pairs, i.e. work on Piaget and Vygotsky in the same pair. OK?). [Setting 2, #48, 25.10, DS1, forum class group]
t6.5	elaboration of the task content	However, it needs to be pointed out that the way in which you use the various outlines in the interpretation is open to debate: the outlines are alternative views as to what the main factors responsible for the student's learning process in a classroom situation are. In this sense, therefore, they are essentially incompatible with each other; one or another is chosen as a basis for interpretation according to whatever the theoretical framework may be, but they cannot all be used at the same time. [Setting 1, document linked to #103, 10.11, DS1, forum group 1]
t6.6		What we have to take into account first of all is that the instruments, for Vygotsky, enable people to transform their surroundings. Hence he speaks of the parallels between the material instruments that individuals use to modify and regulate nature, and the psychological instruments, such as language, that mediate the psychological functions. [Setting 2, #39, 23.10, DS1, mail student E]
t6.7	course management	Following what I told you in my last message in this forum, given that I have received no messages against, I'll "post" the Activity 3 carried out by each group as documents for Stage 1 so that you can use them as another element for checking with regard to Activity 4. You'll find them with the rest of the documents and activities for the Stage. [Setting 1, #509, 25.11, DS1, forum class group]
t6.8		I'm attaching two documents: one is the presentation of Activity 3, and the other has the table explaining the activity. You already know that you have to continue working in groups like you've been doing up to now (...) Read them very carefully, follow the instructions to the letter and don't hesitate to ask me for help whenever you need it. [Setting 2, #105, 11.11, DS2, forum class group]
t6.9	use of technological resources	As you already know, this is the space you'll normally use to speak to the other people in your group, prepare group activities and ask me any questions about the different tasks we'll be carrying out. [Setting 1, #2, 10.10, DS1, forum group 3]
t6.10		A few points about using and managing the group space: 1. All the attached documents for the different tasks will be posted in the "File Area". 2. Organize your messages in folders by topic or task so that it will easier for me and you to access the preliminary information. [Setting 2, #19, 17.10, DS1, forum class group]
t6.11	social atmosphere	I'm sure that a week without having to interact with your fellow students means that you'll be ready to tackle this new activity with renewed enthusiasm. I realize that we're slowly approaching the end of term, but that shouldn't make us lose our rhythm in the practical work or our desire to learn from it. [Setting 1, #525, 29.11, DS2, forum class group]
t6.12		I don't want the mark to affect your enthusiasm or will to learn in Activity 3. I think it's a really nice module that helps us learn some very interesting things from the point of view of Educational Psychology's approach to

Table 6 (continued)

Aspect of the task on which he was offering assistance

t6.13		different educational contexts. So come on, let's go for it, and ask me for help whenever you need it, OK? All the best. [Setting 2, #119, 19.11, DS2, forum group 3]
t6.13	Moment in which the assistance was offered	
t6.14	before	You've now got the continuation of the narrative open along with Activity 7, plus a couple of documents to help you with it. As you can see, Activity 7 involves checking the aspects and indicators to observe against those drawn up by the case psychologist, then proposing an "improved version" of your Activity 6 based on this comparison. [Setting 1, #116, 15.11, DS2, forum group 1]
t6.15		I'm sending you two documents like in Activity 1: one is a presentation of the activity and the other has an explanatory table. Please read both documents very carefully. While you were preparing Activity 1 you asked me lots of things that were already covered in the documents. OK? [Setting 2, #2, 12.10, DS1, forum class group]
t6.16	during	Remember, apart from the formal questions, that it is fundamental that all members of the group must have participated actively in preparing Activity 3, and that it must be possible to see this participation in the exchanges between you in your group workspace. [Setting 1, #53, 21.10, DS1, forum group 1]
t6.17		The new context doesn't need to be included in Task 9, but obviously it won't be a problem if you want to include it. [Setting 2, #188, 06.12, DS2, forum group 1]
t6.18	after	However, given that the case psychologist's proposal is clearly different to yours, I understand that it would have been relevant to justify and argue where, in your proposal, the different dimensions and indicators that the case psychologist proposes are to be found, and why you consider that these dimensions and indicators are not capable of providing elements to improve your initial proposal. [Setting 1, document linked to #129, 29.11, DS2, forum group 1]
t6.19		In general it went quite well. Some of you managed to integrate the knowledge we've been working with throughout the course, which indicates that you've built up your own knowledge. [Setting 2, #233, 30.12, DS2, forum class group]
t6.20	Recipient of the assistance	
t6.21	class group	Remember that it's handed in via Moodle, attaching the corresponding files using the forms you can find at the end of the announcement of each task, and you can access it from the main classroom for the course. Please don't send me activities by e-mail. [Setting 1, #506, 17.10, DS1, forum class group]
t6.22		Read the presentation with the materials in front of you so you can see the different sections, and if you've got any questions let me know. OK? Come on, it's the last module! [Setting 2, #104, 11.11, DS2, forum class group]
t6.23	small group	I've received two versions of Activity 7: one from D., in the early hours of Saturday, and one from M., on Saturday morning. I've looked at them both and I can see that they're slightly different, but I'm not absolutely sure which one you consider definitive. Can you let me know? [Setting 1, #219, 22.11, S2, forum group 2]
t6.24		Just to let you know that in this activity there is no task that needs to be presented individually, since all the ones that were done individually had to be looked over afterwards by another member of the group, and therefore there's no need to put names (I've already done the monitoring of the one you handed in individually). As far as Task 6 is concerned, the questions

t6.25 **Table 6** (continued)

Aspect of the task on which he was offering assistance		
t6.25	individual student	refer to all the contexts, and the one you proposed as a group is also included. [Setting 2, #187, 06.12, DS2, forum group 1]
t6.26	Root of the assistance	In order to complete your computer “registration” process in the course web space, I need you to send me the user name and password you used to register on the Moodle platform. Please send it to me at this e-mail address as soon as you can. [Setting 1, #7, 13.10, DS1, mail student C]
t6.27	spontaneous	Don’t worry too much about the subject of physical instruments because the most relevant ones from the point of view of Vygotsky are the psychological instruments, which are the ones that really work as mediators and enable and encourage higher psychological processes. [Setting 2, #46, 25.10, DS1, mail student E]
t6.28	requested	The basic aim of Activity 4 is for you to be able to carry out self-evaluation and a critical reflection of the register and interpretation that you made in Activity 3, using as elements of comparison your own impression of the product you made, the documents drawn up by the case psychologist (that you’ve got posted in the main classroom), and the theoretical concepts of the constructivist idea (as far as you’ve worked with them in class). [Setting 1, #67, 22.10, DS1, forum group 3]
t6.29		I can see that this thing about the pages is making you go really fast. If you’ve managed to get them down to 17 that’s fine. Leave it as it is, OK? [Setting 2, #256, 19.12, DS2, forum group 2]
t6.30		As regards the question you asked me about the support documents, these are usually materials that you need or that can help you to carry out one or more of the tasks. So far you’ve only got one: document I.1. “Coordinates of the recorded class...”. [Setting 1, #4, 12.10, DS1, forum group 2]
t6.31		Concerning a message G. sent me about a query regarding Task 7, I have to tell you that you only have to answer the questions in the second section referring to three contexts: TV, family and school. OK? [Setting 2 #215, 10.12, DS2, forum group 2]

out of 35), whereas the teacher in Setting 2, although he also mainly addresses small groups (18 interventions out of 29), has a significant number of interventions (11 out of 29) addressed to the class group or to individual students.

Finally, the two teachers’ interventions in the two settings also differ when we consider whether they are spontaneous or in response to a student request (see Table 9; see also Table 6 for examples). In Setting 1, almost all the interventions are made spontaneously by the teacher (34 out of 35), whereas in Setting 2 there is a more balanced distribution and we find that as many as ten interventions out of 29 are made after a question from one of the students.

t7.1 **Table 7** Number of teacher interventions to provide assistance with planning and organizing the work or elaboration of the tasks made before, during and after the groups’ collaborative work on the various tasks

t7.2		Before	During	After	Total
t7.3	Setting 1	22	1	12	35
t7.4	Setting 2	4	18	7	29

Table 8 Number of teacher interventions to provide assistance with planning and organizing the work or elaboration of the tasks addressed to the class group, a particular group of students or an individual student

	Class group	Small group	Individuals	Total
Setting 1	4	31	0	35
Setting 2	7	18	4	29

In our opinion, the differences in the way the teachers intervene in the two settings are not as interesting when considered singly with each aspect separate as they are when considered together, outlining a certain specific pattern in the way assistance is given in each setting. Thus we find that the teacher in Setting 1 offers assistance a greater number of times as regards the elaboration of the tasks, their content and the production of the corresponding written work; he provides assistance before the students begin the task (framing and preparing the ground for using the case script) and also once they finish (commenting on the work produced and the process followed); he offers assistance to the groups on the basis of individual need; and he provides assistance when he believes it is appropriate, based on his monitoring of the students' work and without waiting for them to ask. The teacher in Setting 2, on the other hand, mainly provides assistance involving the organization and working of the groups; the assistance is offered while the groups are carrying out the task, typically to remind them or tell them to return to the instructions of the peer review script established for the task; it is often aimed at the class group as a whole or at individual students and in response to specific questions.

The remaining results will show us whether these different patterns of assistance (which must also be interpreted by simultaneously considering the previous scripting of the task in each setting) are linked to different results for the groups as regards the ways in which they organize and coordinate their work and as regards their progress towards collaborative knowledge construction.

The forms adopted by the groups to plan, organize and coordinate the work

Tables 10 and 11 show the ways in which the work was planned, organized and coordinated by the different student groups in each of the settings analyzed and for each of the tasks. The results showed clear differences between the groups in both settings. In Setting 1, the groups show heterogeneous forms of planning, organization and coordination, both among themselves and on different tasks, in such a way that all the groups carry out one task or another in each of the three ways considered in our analysis (jigsaw coordination, chain coordination, star coordination). Also, these evolved in the course of the DSs in such a way that each group ends up adopting a predominant form (chain coordination in Groups 1 and 2, star coordination in Group 3). In Setting 2, however, the groups organize and coordinate themselves in very similar ways in each case, adhering strictly to the instructions in the

Table 9 Number of teacher interventions to provide assistance with planning and organizing the work or elaboration of the tasks offered spontaneously or in response to student request

	Spontaneous	Request	Total
Setting 1	34	1	35
Setting 2	19	10	29

t10.1	Table 10 Forms of organizing and coordinating the groups' work (Setting 1)			
t10.2	Group	DS	Task	Forms of organizing and coordinating the groups' work
t10.3	Group 1	DS1	1.1.	star coordination
t10.4			1.2.	jigsaw coordination
t10.5			1.3.	jigsaw coordination
t10.6		DS2	2.1.	chain coordination
t10.7			2.2.	chain coordination
t10.8			2.3.	star coordination
t10.9			2.4.	chain coordination
t10.10			2.5.	chain coordination
t10.11	Group 2	DS1	1.1.	star coordination
t10.12			1.2.	jigsaw coordination
t10.13			1.3.	jigsaw coordination
t10.14		DS2	2.1.	chain coordination
t10.15			2.2.	chain coordination
t10.16			2.3.	chain coordination
t10.17			2.4.	chain coordination
t10.18			2.5.	chain coordination
t10.19	Group 3	DS1	1.1.	star coordination
t10.20			1.2.	chain coordination
t10.21			1.3.	jigsaw coordination
t10.22		DS2	2.1.	star coordination
t10.23			2.2.	chain coordination
t10.24			2.3.	star coordination
t10.25			2.4.	star coordination
t10.26			2.5.	star coordination

t11.1	Table 11 Forms of organizing and coordinating the groups' work (Setting 2)			
t11.2	Group	DS	Task	Forms of organizing and coordinating the groups' work
t11.3	Group 1	DS1	1.1.	as requested by the script
t11.4			1.2.	as requested by the script
t11.5		DS2	2.1.	as requested by the script
t11.6			2.2.	as requested by the script
t11.7	Group 2	DS1	1.1.	as requested by the script
t11.8			1.2.	as requested by the script
t11.9		DS2	2.1.	as requested by the script
t11.10			2.2.	as requested by the script
t11.11	Group 3	DS1	1.1.	as requested by the script
t11.12			1.2.	as requested by the script
t11.13		DS2	2.1.	as requested by the script
t11.14			2.2.	as requested by the script

initial script provided by the teacher. We can only point to a slight difference between groups as regards the level of responsibility and control taken on by whichever student is put in charge of the task. In this respect the level of responsibility and control exercised by the students in charge of each task is appreciably lower in Group 3 compared to Groups 1 and 2 in terms of putting forward proposals and taking decisions and also taking the initiative in consulting the teacher. This difference does not, however, affect the way the group is organized as such, this being the same as in the other groups. Neither do we find an evolutionary process in the forms of planning, organization and coordination in the course of the DSs in each case, beyond their strict adherence to the instructions provided.

The phases of collaborative knowledge construction achieved by the groups

There are also relevant differences between the groups in both settings in terms of the results relating to the phases of collaborative knowledge construction achieved by the various groups in the various tasks (see Tables 12 and 13). The groups in Setting 1 achieved the most advanced phases of collaborative knowledge construction for a greater number of tasks. Specifically, Group 3 achieves the negotiation or co-construction phase (the two most advanced phases) in five of the eight tasks it carries out in the two DSs, while Group 2 does so in six of the eight. In total, the different groups achieve these more advanced phases in 11 of the 24 tasks carried out in the course of the two DSs. In Setting 2, however, only one group achieved either of these phases, and that was in just one of the four tasks it carried out (just one out of the 12 tasks carried out in the course of the two DSs). In Setting 1, on the other hand, we find that progress is made in the course of the two DSs in the phases achieved by the groups, especially Groups 2 and 3: Group 3 achieves the higher phases in one of the three tasks it carries out in DS1 and in all five tasks in DS2; Group 2 does not reach the higher phases in any of the three tasks in DS1, but does in all five tasks in DS2. However, this progress does not appear in Setting 2: the only higher phase reached by a group is in the first task of DS1; all the later tasks without exception are resolved using processes belonging to the lower two phases considered in the analysis. Apart from this, as can be seen from the data given earlier, there was greater heterogeneity between the groups in Setting 1 than in Setting 2, in a similar way to what happened with the forms of planning, organizing and coordinating the work.

Discussion

As a whole, our results showed that, in each of the settings analyzed, the groups exhibited specific forms of group work organization and different levels of collaborative knowledge construction, which it seems may be related to the patterns of assistance offered by the teacher in each setting and the characteristics of the script within which the assistance is framed.

Hence the forms of group work in the Setting 1 groups –taken as a whole and in comparison to those of the Setting 2 groups– exhibit three characteristics we can highlight. The first is a greater heterogeneity between the different groups. This affects both the forms adopted for planning, organizing and coordinating the work (the groups show heterogeneous forms of planning, organization and coordination among themselves and in different tasks) and the collaborative knowledge construction phases achieved (some groups typically achieve more advanced phases than others, and any particular group does not always achieve the same phase in different tasks). The second characteristic we can

Table 12 Phases of collaborative knowledge construction and final grades (from 0 to 3) given by the teacher for each small group (Setting 1)

Group	DS	Task	Phases of collaborative knowledge construction	Grade
Group 1	DS1	1.1.	II. Exploration Phase	2
		1.2.	II. Exploration Phase	
		1.3.	I. Initiation Phase	
		2.1.	II. Exploration Phase	
		2.2.	II. Exploration Phase	
Group 2	DS1	2.3.	II. Exploration Phase	2,5
		2.4.	II. Exploration Phase	
		2.5.	II. Exploration Phase	
		1.1.	I. Initiation Phase	
		1.2.	I. Initiation Phase	
	DS2	1.3.	II. Exploration Phase	
		2.1.	IV. Co-Construction Phase	
		2.2.	III. Negotiation Phase	
		2.3.	III. Negotiation Phase	
		2.4.	IV. Co-Construction Phase	
Group 3	DS1	2.5.	IV. Co-Construction Phase	3
		1.1.	III. Negotiation Phase	
		1.2.	II. Exploration Phase	
		1.3.	I. Initiation Phase	
	DS2	2.1.	IV. Co-Construction Phase	
		2.2.	III. Negotiation Phase	
		2.3.	IV. Co-Construction Phase	
		2.4.	IV. Co-Construction Phase	
		2.5.	IV. Co-Construction Phase	

Table 13 Phases of collaborative knowledge construction and final grades given by the teacher for each small group (Setting 2)—possible grade, from higher to lower: A, B, C+, C-

Group	DS	Task	Phases of collaborative knowledge construction	Grade
Group 1	DS1	1.1.	IV. Co-Construction Phase	A
		1.2.	II. Exploration Phase	
		2.1.	II. Exploration Phase	
Group 2	DS2	2.2.	II. Exploration Phase	B
		1.1.	II. Exploration Phase	
		1.2.	II. Exploration Phase	
	DS1	2.1.	II. Exploration Phase	B
		2.2.	II. Exploration Phase	
		2.2.	II. Exploration Phase	
Group 3	DS1	1.1.	II. Exploration Phase	C-
		1.2.	I. Initiation Phase	
	DS2	2.1.	II. Exploration Phase	B
		2.2.	I. Initiation Phase	

highlight was that, in the course of the DSs, the different groups showed consistent evolution. On the one hand, over the course of the process the groups adopted one predominant form for planning, organizing and coordinating the work (chain coordination in Groups 1 and 2, star coordination in Group 3). On the other hand, the groups (especially Groups 2 and 3) improved their processes of collaborative knowledge construction along the DSs, achieving much higher phases in the tasks of DS2. The third characteristic to highlight is that, overall (and related in some way to the progress that we have just pointed out), the Setting 1 groups achieve higher collaborative knowledge construction phases in the DSs taken as a whole.

Our interpretation is that these three characteristics may be related to the characteristics of the pattern of assistance offered by the teacher in Setting 1 and the characteristics of the Case script within which this pattern of assistance is framed. As we mentioned earlier, the Case script used in this setting is a basically epistemic script, which leads the students through the entire sequence of tasks to be carried out but does not go into detail about the way in which each task should be carried out, nor the way in which the students should organize themselves as a group. Given such a framework, the groups would be expected to organize themselves and work heterogeneously, especially at the start of the DSs. At the same time, the teacher offers various types of assistance which, as we interpret it, enables the groups to be oriented and guided in a personalized and flexible manner throughout the DSs: he offers assistance before the tasks to explain, frame and support the use of the script, he makes comments and proposals after the tasks which give feedback to the groups, he directs his assistance to each group in a specific way and he closely monitors the groups' work, which enables him to provide assistance spontaneously when he believes he should. All this may help to explain the progress of the groups over the course of the DSs: the fact that in the end they identified what forms of planning, organizing and coordinating the work were most efficient for them, and the fact that they carry out the tasks using more and more advanced collaborative knowledge construction processes. Finally, the fact that both the Case script and the teacher's assistance focused primarily on questions relating to the elaboration of the tasks, their content and the production of the corresponding written work (and not only or not primarily on the organization of the group work) may make it easier for the groups to achieve better results from the point of view of the collaborative construction they carry out.

Overall the results for the groups in Setting 2 are the reverse. There is great homogeneity between the groups, both as regards organization of work (the Peer review script instructions are followed faithfully in all cases) and elaboration of tasks (constantly located in Phases 1 and 2 of the collaborative knowledge construction model used in our analysis). We find no progress over the course of the DSs in either of the two aspects analyzed, and the level of collaborative construction is consistently low, both in absolute terms and in comparison with Setting 1.

Our interpretation again is that these characteristics may be related to the characteristics of the pattern of assistance offered by the teacher in Setting 2, and the characteristics of the Peer review script within which this pattern of assistance is framed. As mentioned earlier, the script used in this case includes very detailed instructions on group organization and the roles and sub-tasks to be carried out by each member. There is undoubtedly a link between this degree of detail and the homogeneity between the different groups, especially in the ways in which the work is coordinated, scrupulously following the instructions given. In addition to this, the pattern of assistance offered by the teacher only strengthens these instructions and the need to follow them literally: assistance focuses primarily on questions relating to the organization and functioning of the groups and consists mainly of reminders

and clarifications of the script instructions provided while the tasks are being carried out. Also, in many cases this assistance does not involve close monitoring or guidance for any one particular group but is aimed at the group class as a whole or at individual students. All this emphasizes yet more the role of the script as the central and almost exclusive core of the students' work. Within this framework, questions relating to the planning, organization and coordination of work –arising from both the script and the teacher's help– may in the end have much more relevance for the students than the actual content of the tasks, and this, in our opinion, may be linked to the groups' low overall levels as regards the collaborative knowledge construction phases achieved.

Set down in this way, the results of our study as a whole highlight first of all how difficult it is to ensure that groups that work in CSCL environments achieve high levels of collaborative knowledge construction, thereby getting involved in authentic processes of negotiation and co-construction of meanings. The difficulty involved in this has been highlighted repeatedly in previous papers on the subject (Arvaja et al. 2003; Järvelä and Häkkinen 2002; Kirschner et al. 2008; Kobbe et al. 2007; Lipponen 2002; Rourke and Kanuka 2007; Weinberger et al. 2005). In a similar way to what these papers show, a large part of the tasks set to the participating groups in our study was resolved using collaborative construction processes that we may consider to be "low level". In the tasks analyzed, which concerned producing various types of written work, these processes basically involved creating a written text based on the juxtaposition of parts or contributions written by each person individually and barely revised or discussed, following a kind of logic very close to that of the "cumulative talk" described by Mercer (1995, 2000).

Secondly, and in this framework, our results appear to support the idea that the use of certain forms of instructions in collaborative work processes –or scripts– may affect the work forms adopted by the groups. This also coincides with the findings of a number of previous papers (i.e. De Wever et al. 2009; Dillenbourg and Jermann 2006; Hämäläinen and Häkkinen 2010; Kirschner et al. 2008; Rummel and Spada 2005; Schellens et al. 2007; Slob et al. 2010; Stegmann et al. 2007). Indeed the results we have obtained relating to the forms used to plan, organize and coordinate the work by the groups in Setting 2, for example, would be difficult to explain without reference to the presence and characteristics of the peer review script used in that setting.

Despite this, these same results show that the influence a script can have on the collaborative work processes is not always positive and highlight the risk of "overscripting" (Dillenbourg 2002) the interaction between group members. As Dillenbourg points out, when this "overscripting" occurs, the participants end up paying more attention to the "syntax" of the instructions (the literalness of the sub-tasks, steps and roles the instructions prescribe) than the "semantics" (the mechanisms of collaborative knowledge construction they try to promote) in such a way that they follow them literally and carefully, but without this resulting in any real advance in their processes of collaborative working on the task or their joint understanding of the content. In this case the instructions become a kind of list of requirements to fulfil and do not give any guidance as to the sense or the characteristics of the collaborative process that should be developed (Weinberger et al. 2002; Weinberger et al. 2005). The results for Setting 2, where the groups' scrupulous following of the instructions are combined with invariably low levels achieved in phases of collaborative knowledge construction, are in our opinion a good illustration of this phenomenon.

Beyond these issues, however, our opinion is that the most relevant point to be taken from the results of our study as a whole is that they show the influence of the patterns of teacher assistance on the forms of group collaborative work in the different settings and the impact of this assistance on the effects of the scripts used in each case. This point can be

seen particularly in the results for Setting 1, especially in terms of the evolution and progress of the groups in the course of the DSs analyzed. The evolution of the groups in this setting cannot be explained only by the characteristics of the Case script used; these characteristics and the pattern of teacher assistance need to be taken into consideration together. The case script used may, because of its relatively open character, possibly have a bearing on the initial heterogeneity of the groups, but the later evolution both in the forms of planning, organizing and coordinating of the groups and in their collaborative construction processes seem to be clearly linked to the ways in which the teacher offers assistance throughout the DSs. Similarly in Setting 2, the pattern of teacher assistance serves to reinforce the characteristics of the script and provide a clearer explanation of the fact that, during the entire development of the two DSs, the groups do not stray away from the initial instructions in the slightest but stick to them as unanimously and strictly as they do. Also in this respect, the differences in the collaborative knowledge construction phases achieved by the groups in both settings appear to be better explained if we simultaneously take into account the characteristics of the script used in each case and the pattern of assistance offered by the teacher.

From this interpretation, the main question to be explored would not be which scripts are generally more useful and effective, but rather how certain patterns of teacher assistance combine with certain scripts, thereby boosting (or not) the desired effects of these scripts. This kind of approach would be aimed at discovering which patterns of teacher assistance might best increase the effectiveness of a particular script in particular teaching and learning situations with their own particular characteristics. This kind of integrated approach, which combines the study of scripts and the study of teacher assistance patterns, is consistent with certain recent proposals in the field of CSCL which stress the importance of the teacher as a guide in the collaborative processes of student groups (Anderson et al. 2001; De Laat et al. 2007; Dillenbourg and Hong 2008; Kirschner et al. 2006; Lockhorst 2004; Veldhuis-Diermanse 2002). This importance is linked to the idea that, in CSCL environments, the processes of structuring the interaction before it begins and regulating it while it develops are reciprocally dependent processes that influence each other in such a way that teachers should constantly be regulating the use students make of the scripts (Dillenbourg and Hong 2008). The notion of *orchestration* has been put forward and developed within this framework to refer to the process of flexibly and productively coordinating the help that the teacher needs to follow, on different levels and different planes, in CSCL environments (Dillenbourg and Fischer 2007; Dillenbourg et al. 2009; Dillenbourg and Tchounikine 2007; Fischer and Dillenbourg 2006). Our results support this idea and in particular stress one key aspect of this orchestration process: the need for the teacher to adapt the designed activities in real time to what is actually taking place in the classrooms, framing and complementing the instructions provided by the script, making them more flexible depending on the actions of the groups during the process. Equally, our results underline the need to analyze the teacher's intervention over relatively long periods of time, enabling an understanding of how the groups' collaborative work evolves related to the teacher's pattern of assistance.

We are, however, aware that the results obtained should be interpreted with a certain amount of caution due to the characteristics and limitations of our study. These limitations concern, for instance, the observational character of the study, which limits control and manipulation of the different involved variables (the types of script used or the patterns of teacher assistance, but also the technological resources available or the specific learning content/tasks). Subsequent studies under more controlled conditions will no doubt provide a better understanding of the combined contribution of certain types of script and certain types of patterns of assistance in the group collaborative work processes. In particular, it

would enable a more systematic exploration of the question concerning the impact of the various elements of the scripts used, as well as the level of detail they contain, i.e. in terms of “macro-scripts” vs. “micro-scripts” (Dillenbourg and Hong 2008). It would also enable the study of advances and progress in the forms of the groups’ collaborative work and the individual learning of their members to be linked; a crucially important issue that we have not dealt with here. The study would also need to be replicated in other instructional settings, with tasks calling for written work of various types to be produced, possibly with the support of other technological platforms, to better establish the scope of the results obtained. In addition to this, we believe that a more detailed analysis of the teacher’s assistance should be carried out, for example by finer discourse analysis techniques, which would provide a better understanding of when and how certain interventions successfully “scaffold” the groups’ actions, thereby helping us to understand the reason for the effectiveness (or not) of certain patterns of teacher assistance in the framework of certain scripts.

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