Analyzing the Role of Students’ Self-Organization in a Case of Scripted Collaboration

Pantelis M. Papadopoulos, Stavros N. Demetriadis, Ioannis G. Stamelos
Aristotle University of Thessaloniki, PO Box 114, 54124, Thessaloniki, Greece
Email: pmpapad@csd.auth.gr, sdemetri@csd.auth.gr, stamelos@csd.csd.auth.gr

Abstract: This work analyzes a case of computer-supported scripted collaboration, focusing on how students’ self-organization affected the actual collaboration script during script run-time. Two groups of students studied learning material using a web environment designed for supporting case-based learning. The first group followed a non-scaffolded individual mode of study while students in the second group were guided by a collaboration script to work (in dyads) on the case material. Statistical analysis indicated no significant differences in the learning outcomes of the two groups. Qualitative analysis (based on students’ interviews and field observations) revealed that students’ self-organization resulted to a broad range of actual script implementation ranging from full conformance to partial violation of the script guidelines. The paper discusses the socio-cognitive role of students’ self-organization during scripted collaboration and presents suggestions for the teacher and CSCL designer in order to enhance the engagement of collaborating students to productive learning interactions.

Introduction

Computer-supported collaborative learning (CSCL) has drawn much attention as a teaching/learning approach and is frequently implemented at all levels of education (Dimitracopoulou & Petrou, 2005). However, researchers have repeatedly emphasized that collaborating students may fail to engage in productive learning interactions when left without teachers’ consistent support and scaffolding (e.g., Dillenbourg, 2002; Barron, 2003). To increase the probability that team partners will collaborate efficiently it has been suggested to guide the activity using “collaboration scripts” (e.g., O’Donnell & Dansereau, 1992; Weinberger, 2003). A collaboration script is a teacher-provided didactic scenario designed to engage a team of students in essential knowledge-generating interactions by providing guidelines on how to organize the collaborative learning activity. A computer-supported collaboration script is, accordingly, a computerized representation of a collaboration script (e.g., Kollar, Fischer & Hesse, 2006) and “scripted collaboration” is the practice of actually implementing a collaboration script to have students work within the scaffolding framework provided by the teacher.

Nevertheless, guiding collaborating students with a script is not a straightforward process. A script, typically, is conceived by an instructor as a helpful tool that will engage the team of students in meaningful learning. However, once it leaves the teacher’s mind it becomes a socio-cognitive entity which, not only may affect student learning in ways unforeseen by the teacher (for example by restricting natural collaboration; see Dillenbourg, 2002), but it might also be affected by students during the process of appropriating the script within their own context (Tchounikine, 2007). From this perspective it is interesting to explore how students’ self-organization process interacts with the script framework during collaboration. Tchounikine (2007) defines students’ “self-organization” as “the metalevel activity that a group of learners engaged in a CSCL script may engage in so as to maintain, within the reference frame that is externally defined by the script, a more-or-less stable pattern of collective arrangement”. Although in scripted collaboration the script prescribes to a great extent the conditions for collaboration, students’ self-organization is expected to emerge and play an important role whenever the script allows (and perhaps encourages) them to take their own decisions for organizing the collaboration. However, as this work shows, students’ self-organization (especially when students work in distance mode without the teacher being present) may also have unpredictable and undesired impact on the implementation of a collaboration script.

In the following, after a concise theoretical background, the paper presents the design and the results of the study, regarding (a) the learning outcomes of students in two conditions (individual learning vs. scripted CSCL) and (b) four different patterns of actual script implementation. The discussion is then focused on analyzing how students’ self-organization (strongly connected to students’ motivation and metacognitive skills) interacted with the script and even resulted to violating some specific script guidelines. As a conclusion, it is suggested that scripted collaboration may also “suffer” from students’ self-organization activity and proactive teacher/designer
interventions are needed to manage the script implementation in a way that students’ self-organization becomes a helpful asset of the collaboration instead of a possibly threatening factor.

Theoretical Background
Scripted Collaboration and Students’ Self-Organization

Collaborative learning may often result to detrimental learning due to student failure to collaborate effectively. Productive learning interactions do not happen spontaneously within the team and research has consistently revealed that freely collaborating students may lack the competence to engage in fruitful learning interactions without external support and guidance (Liu & Tsai, 2008). To heal this shortcoming researchers have suggested various approaches to guide the collaboration activity, such as intelligent CSCL (e.g., Soller, Lesgold, Linton & Goodman, 1999) and scripted collaboration (e.g., Weinberger, 2003).

The scripted collaboration approach aims to guide the collaboration activity by using specific didactic scenarios. It is suggested that by implementing an appropriate collaboration script one increases the probability of productive student-student and student-teacher learning interactions. Indeed, scripted collaborative learning has been reportedly resulted in improved learning outcomes (Kollar, Fischer & Slotta, 2005; Rummel & Spada, 2007; Weinberger, Fischer & Mandl, 2002).

Computer-supported collaborative learning scripts (or simply CSCL scripts) are computer-based representations of collaboration scripts, where the computer is employed as a means to deploy the script representation and also to support learners with communication functionalities (Tchounikne, 2008). Lately, the considerable interest that the scripting approach has gained in the CSCL community has motivated efforts for the formalization of collaboration scripts (Köbbe, Weinberger, Dillenbourg, Harrer, Hämäläinen & Fischer, 2007) and the development of computer-based environments for the authoring and operationalization of CSCL scripts (e.g., Hernández-Leo et al., 2006; Turani & Calvo, 2007).

However, even though the script provides a scaffolding framework for the collaboration, the actual implementation of a script raises two – at least – major issues that need careful consideration, before or during script run-time. First, it is the issue of avoiding “overscripting” conditions. Overscripting as Dillenbourg (2002) points out is the danger of restricting the creativeness of free (non-scripted) collaborative setting in favour of a teacher-led guidance of collaborative activity that is promoted by the scripting approach.

Second, it is the issue of script appropriation through students’ self-organization activity. In free collaboration the students are expected to develop their own self-organizing patterns in order to successfully reify the activity. Instead, scripted collaboration already provides an organizing framework for the collaborating students. However, script implementation is subject to students’ appropriation process, meaning that students are expected to “filter” and adjust the script to their own context during run-time. Dillenbourg (2004) underline this distinction suggesting that one should distinguish between ideal (the activity as prescribed by the teacher), mental (the mental script representation that the group builds from teacher’s prescription) and actual (the actual task and interactions that students engage) script in order to conceptualize the different teacher’s and students’ script perspective.

Question Prompting and Peer Interaction as Student Scaffolding Techniques

The long-term perspective of our research is how to better support students when learning in ill-structured domains, by implementing effective scaffolding techniques in technology environments. The two pillars of our scaffolding approach is (a) question prompting and (b) peer interaction.

Question prompts are sets of questions, used to guide and facilitate the learning process offering both cognitive and metacognitive support to students. They usually appear in the form of procedural, elaboration or reflection prompts and they have consistently proven to be of value in diverse situations. Research on elaborative interrogation revealed that this type of question prompts can result in greater factual and inference learning (e.g., Woloshyn, Willoughby, Wood & Pressley, 1990). Question prompts have been used in technology-enhanced learning environments to help direct students towards learning-appropriate goals such as focusing student attention, modelling the kinds of questions students should be learning to ask, and helping make their thinking visible and thus an object for reflection (e.g., Azevedo, Cromley & Seibert, 2004).

The socially oriented “peer interaction” approach to learning (or collaborative learning) is rooted in the ideas of Vygotsky (1978) who argued that interaction with others is a fundamental mechanism of learning. Several research studies (e.g., Cohen, 1994; Webb & Palincsar, 1996) provided evidence that essential learning emerges as a byproduct of the cognitive activity that can be triggered when interacting with others. It is expected that the activity initiated through peer interaction help move a person to higher levels of thinking through articulation of their own
understanding, testing of arguments, modification of ideas and activation of judgment and reasoning skills Berge and Collins (1995).

For the purposes of our research we have developed a technology-enhanced learning environment for case-based learning (eCASE) and applied a context-based questioning strategy to support students analyze the context of complex case material. So far we have focused on conditions of individual learning and we have demonstrated that students who are being scaffolded by question prompts perform significantly better when compared to the non-scaffolded students (Demetriadis, Papadopoulos, Stamelos & Tsoukalas, 2008).

In this paper, we present the outcomes of a next study implementing a scaffolding approach that comprises both question prompts and guided peer interaction. Our objective was to record the benefits emerging for the students of the computer-supported collaborative learning condition. We expected that these students would perform significantly better than those in the individual study non-scaffolded condition. However, as we explain in the following, neither the CSCL condition achieved better learning outcomes nor the students’ interaction patterns were always as dictated by the collaboration script.

Overview of the Study

Goal of the Study and Research Questions

The first goal of the study was to compare the learning outcomes between two conditions of computer-supported study in ill-structured domain: non-scaffolded individual learning vs. prompted scripted collaboration. A second objective was to investigate the scripted collaborative learning experience of the CSCL group and analyze how student teams organize their activity guided by the script.

Method

Participants

The study employed 40 Computer Science students (20 males and 20 females in their 3rd out of 4 years of studies) who volunteered to participate. The students were domain novices (this was a prerequisite for participation) and they had never before been typically engaged in case-based learning as undergraduates. Students who successfully completed all the phases of the study were given a bonus grade for the laboratory course.

The 40 students were asked to choose whether they would like to work collaboratively or not. Initially, only 8 dyads were voluntarily formed (3 male-male and 5 female-female). We additionally assigned 4 male students (selected randomly) to work in 2 dyads. Overall, the two study conditions were as follows:

- CSCL group: 20 students (10 males and 10 females)
- Individual Learning (IL) group: 20 students (10 males and 10 females)

However, a dyad dropped out during the study and so the final CSCL group distribution was 5 male-male and 4 female-female dyads.

Material

The domain of instruction was Software Project Management (SPM), a domain of considerable complexity and need for knowledge transfer in job-related situations. SPM was chosen because it is hard to teach and learning relies largely on past experiences and project successes and failures. Difficulties in this domain stem from the fact that software processes are not well-defined, their product is intangible and often hard to measure, and large software projects are different in various ways from other projects (Sommerville, 2004). In addition, many aspects of SPM are not adequately formalized and involve subjective quantification, e.g. risk prioritization. As a consequence, software managers recall and use their knowledge about projects they have managed (or are aware of) in the past, and base their decisions on management patterns and anti-patterns. It is worth mentioning that this field has been ranked first among 40 computer science topics whose instruction needs to be intensified in academia because of demands in professional context (Kitchenham, Budgen, Brereton & Woodall, 2005).

For the purpose of our research, we developed eCASE, a web environment for case-based learning. Studying in eCASE involves solving ill-structured problems, presented to students as “scenarios”. A scenario is a problem-case anchoring student learning in realistic and complex problem situations in the field. After presenting the problem, a scenario poses to students some critical open-ended questions (scenario-questions), engaging them in decision-taking processes, as if they were field professionals.

Before answering the scenario-questions the learners are guided to study supporting material in the form of “advice-cases”. An advice-case is a comprehensive case presenting some useful experience in the field that is relevant to the scenario problem. Hence, each scenario in eCASE is accompanied by a number of relevant advice-cases. In order to develop advice-cases we selected and adapted authentic SPM cases reported in the literature (e.g.,
The scenarios presented to students were about various installations of Enterprise Resource Planning (ERP) systems in new or restructured facilities, while the advice-cases referred to similar projects highlighting important domain factors such as the role of end-users, the involvement of senior management, the definition of project goals, and the changing of system requirements. Overall, the students had to suggest a possible solution to the problems depicted in the scenario (by answering the scenario-questions), based on domain past experiences presented in the advice-cases that accompanied the scenario.

**Design**

A pre-test post-test experimental research design was implemented to compare the performance of the two groups (CSCL vs. IL group) with two measures of the post-test as the dependent variables. Additionally, we collected qualitative data to analyze students’ behaviour during the activity. The two groups proceeded through the study in five distinct phases: pre-test, familiarization, study, post-test, interview.

**Pre- and Post-Tests**

The pre-test was a prior domain knowledge instrument that included a set of 6 open-ended question items relevant to domain conceptual knowledge (e.g., “What role can/should the end-users play in the development of a software project?”). The post-test comprised two sections focusing on: (a) acquired domain-specific conceptual knowledge, and (b) students’ potential for knowledge transfer in a new problem situation. The first section included three domain conceptual knowledge questions (e.g., “For which reasons you would encourage/discourage the involvement of end-users in the project development process?”). The answers to these questions were not to be found as such in the study material, but rather to be constructed through a generalization process, by combining parts of information presented in various occasions in the case material. The second section presented a dialogue-formatted scenario. In this scenario, various stakeholders (company CEO, CFO, clients, technicians etc.) were discussing managerial issues of an ongoing software project in an everyday professional context. Students had to identify elements in the scenario that might be indicators of inefficient management and suggest resourceful alternatives.

**Procedure**

In the pre-test phase, students completed the prior domain knowledge instrument. During the familiarization phase, students logged in to the eCASE environment (from wherever and whenever they wanted) and worked on a relatively simple scenario prepared for them, accompanied by two short advice-cases. Students had to read the material in the advice-cases and based on that to provide answers to the scenario open-ended questions. They were allowed one week to complete the activity. The familiarization phase was the same for all students and the objective was to help them familiarize with the content material, the study methodology and the user interface in the eCASE. Although the one week period was rather long for the provided study material, we allowed it to provide ample time for familiarization with the functionalities of the environment.

After the familiarization phase, the students continued with the study phase, which was different for the two groups. This phase lasted one week and the students had to work online on 3 complex scenarios (the same for all groups) that addressed more issues and were accompanied by 5 longer advice-cases. After the study-phase students took a written post-test in class. After the post-test, the students from each group were interviewed to record their comments on the activity.

**Treatment**

For the IL group the study phase was similar to the familiarization phase. The students had to study individually the advice-cases that accompanied a scenario and then propose a possible solution to the problem depicted in the scenario. The eCASE system allowed students to upload their answers to the scenario-questions, after they had navigated through all the advice-cases of the scenario. Students in the IL group were not scaffolded in any way during their study.

By contrast, students in the CSCL group were scaffolded by a collaboration script that orchestrated the collaboration activity (Figure 1). In the core of the script lies a peer review process.

1. In step 1, each student in the team studies the resource (an advice-case) and provides an answer to the prompting questions individually (see next paragraph). After both students have answered the questions, their answers become available to each other.
2. In step 2, the students (individually) have to review each others answers and identify issues of agreement/disagreement.
3. In step 3, the students have to collaborate, discuss their reviews and agree on a common final answer including also argumentation about their choice to present or dismiss issues that appeared in their individual answers. At this point eCASE provides a discussion form to support student collaboration. However, students are allowed to use the medium of their choice during discussion (e.g., face-to-face meeting, phone call, email etc.).

4. The script ends when one of the students in a dyad submits their final common answer in eCASE. Students in CSCL group had to follow the script guidelines when answering the question prompts while studying the advice-cases. Also they applied the same script to answer the scenario questions. The eCASE system allowed students to submit their answers in the scenario-questions only after completing the study of the respective advice-cases. The collaborating students had to self-organize their activity in order to communicate and maintain an efficient pace in submitting their answers.

In order to prompt CSCL student to reflect on the case material we constructed a domain-independent prompting model to trigger those cognitive processes that are relevant to generating and understanding the context of a situation. According to Kokinov (1999), the elements of contextual information that are available to a reasoner are induced from at least three cognitive processes (“context-generating cognitive processes”): perception, memory recall and reasoning. “Perception-induced” context refers to contextual information available through perception of the environment. “Memory-induced” context refers to elements which are recalled from memory and older representations, which are reactivated. Finally, “reasoning-induced” context refers to representations that are derived through reasoning process (for example, while setting goals, defining strategy, etc.).

So, we stated three questions to prompt students to: (a) focus on important events evident in the situation (triggering the perception process), (b) relate these events and their impact to what is already known from other similar situations (triggering the memory recall process), and (c) reach useful conclusions (activating the reasoning process) based also on the results of the two previous steps. We call this the “observe-recall-conclude” prompting scheme and, more specifically the questions were stated as follows:
1. “What concrete events (decisions, etc.) imply possible problems during project development?”
2. “In what other cases do you recall having encountered similar project development problems?”
3. “What are some useful implications for the successful development of a project?”

The “recall” question provided addition ally a “case archive” link for students to navigate and review relevant, already studied, advice-cases. The above questioning scheme was presented to CSCL students at the end of each advice-case they studied.

`Figure 1. The ideal collaboration script for students of the CSCL group (working in dyads)`

**CSCL Students Interviews**
We conducted semi-structured interviews to collect qualitative data on how CSCL students worked and perceived the activity during the study phase. Interviews were conducted for the IL group as well (around students’ attitudes towards the learning environment and the activity as a whole), however the focus was mainly on the CSCL group.
and the actual scripts the dyads followed during their study. In these interviews the objective was to record students’ profile as collaborators and to identify the collaboration patterns the dyads developed. Specifically, we asked students about: (a) their previous experience in collaborative course assignments, (b) their opinion about collaboration in general, (c) their criteria for choosing a partner, (d) the actual script followed in eCASE, (e) their opinion on the collaboration outcomes in eCASE, and (f) their comments about the whole activity.

Data Analysis
Students’ pre-test and post-test answer sheets were assessed by two raters. To avoid any biases, the raters mixed and assessed blindly students’ paper sheets for the pre- and post-test. The raters used a 0-10 scale and followed predefined instructions on how to assess each specific item. The deviation between scores from the two raters was not to exceed the 10% level (one grade on the assessment scale), else raters had to discuss the issue and reach a consensus. Eventually each student received 3 scores: (a) a score for the pre-test, (b) a score for answering domain-specific conceptual knowledge questions (“conceptual” score) of the post-test, and (c) a score for the post-test scenario analysis (“transfer” score). These scores were calculated as the mean values of the respective scores provided by the two raters. As a measure of inter-rater reliability, we calculated the intraclass correlation coefficient (ICC) for the three scores.

For all statistical analyses a level of significance at .05 was chosen. To validate the use of the parametric tests, we investigated the respective test assumptions and results showed that none of the assumptions were violated. To compare students’ prior knowledge in the domain, we conducted t-test and to compare students’ performance in the conceptual and the transfer measures of the post-test we conducted multivariate analysis of covariate (MANCOVA), using the pre-test score as covariate.

The interviews lasted about 10 minutes per student and were audio recorded. We used the interviews transcript for content analysis. Based on students’ statements of how they engaged in the collaboration activity, we classified dyads in different interaction patterns. To further validate the reliability of our classification scheme, we also used data recorded through the system log files (such as students’ actual submitted answers and login frequency).

Results

Statistical Analysis
Table 1 presents the pre- and post-test scores of the two groups. Inter-rater reliability was high for the pre-test, the conceptual, and the transfer score ($ICC = .905$, $ICC = .881$, $ICC = .856$, respectively). T-test results indicated that students were domain novices scoring very low in the pre-test and that the two conditions were comparable regarding students’ prior knowledge ($t(36) = 0.168, p = .868, d = 0.060$). MANCOVA results showed that the main effect of collaboration did not reach statistical significance for the two measures of the post-test (Wilk’s Lambda: $F(2,34) = 0.532, p = .592, \eta^2 = .030$).

Table 1: Students’ performance in the pre- and post-test (scale 0-10).

<table>
<thead>
<tr>
<th></th>
<th>Individual (IL)</th>
<th>Collaborative (CSCL)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>n</td>
</tr>
<tr>
<td>Pre-test</td>
<td>1.43 (0.87)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Conceptual measure</td>
<td>7.78 (1.01)</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Transfer measure</td>
<td>7.75 (1.44)</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

Interviews Analysis
Students of both groups said that eCASE was “friendly” and “easy to use”, even though they had not used a similar system in the past. Additionally, students underlined the role of the presented domain (SPM) on their attitude towards the whole activity, stating that it was interesting and intriguing to study about cases closely related to their future workplace. For example, student CSCL7 said:

By proposing answers to the scenarios I felt like I was part of a company! I found it very interesting to learn about software project management problems and how demanding and complex is developing such projects in real life.
Focusing on the CSCL group, all students stated having worked in teams previously. However their experience with collaborative learning (and especially with scripted collaboration) was very limited, first because their engagement in team work occurred very few times before (one or two experiences) and, second, these experiences were rather of cooperative work (and not collaborative), as students worked on programming assignments in which parts of code development was distributed to team members. Regarding their attitude towards collaboration, all students stated that they prefer working in groups. This was expected, because students were free to choose whether they would be on the IL or the CSCL group. At this point, we should note that the students in the two dyads we formulated to balance the groups’ population did not differentiate from the other CSCL students as they had the same attitude towards collaboration and achieved similar scores in the post-test. It is also worth mentioning that they were no differences between males and females in the two groups regarding both profile and performance. The potential to support learning through multiple perspectives and additional feedback on an issue was the strength that most students (n=14) identified in collaboration. Increased motivation through interaction with peers (n=3) and division of effort (n=3) were also mentioned as collaboration strengths. The majority of students (n=13) said that the option to select their collaboration partner is very important, and the lack of such freedom can affect negatively their attitudes towards collaboration (n=3). The most common criterion for choosing a partner is intimacy and personal relations (n=13), although some students noted that friendly relations is just as important as a person’s level of knowledge, responsibility and ability to communicate (n=6).

Analyzing the collaboration of CSCL dyads revealed four different actual collaboration scripts (Figure 2). Three dyads worked exactly as the ideal script prescribed. Students participated equally throughout the steps of the script and they had a meaningful discussion about the formation of the final answer. It is worth mentioning that these three dyads did not use the same medium for their discussion. Hence, while two dyads used face-to-face meetings, the third dyad used phone calls and on-line chatting extensively. This means that the selection of a specific medium was not always indicative of students’ activity. Student CL17 of the third dyad stated:

> We were discussing the main issues that our final answer should analyze and the actual phrasing.
> For each of the final common answers we submitted, we went through 10 intermediate drafts.

The actual script of two other dyads resembled the ideal script, but with a significant decrease of the interaction between students (“Moderate Interaction” pattern). In the first dyad there was usually a brief discussion about the issues of the final answer, but only one of the students was each time responsible for the final answer. Before the final submission, the final answer was sent to the other student for approval, but this was typical as it was always approved without any comments. In the other dyad, students had agreed to always include any additional
issue raised by either one. Hence, in the discussion they focused on the parts of their individual answers that they
would be replicated in the final answer.

Another two dyads demonstrated a pattern with almost none interaction (“Weak Interaction” pattern). In
these dyads, communication was usually one-sided. After both students submitted their individual answers, one of
them was solely responsible for the formation and submission of the final answer, considering also comments sent
by the other student concerning the two individual answers. The second student was seeing the final answer only
after submission. Student CL6 said:

Usually the one submitting last her individual answer was also responsible for the final answer.
She had to consider her partner’s comments and write and submit the final answer. We trusted one
another on the writing of the final answer and we tried to divide the workload by taking turns on
this task.

Lastly, two other dyads worked in a totally individual mode, as one of the students was usually completely
non-participating after submitting the individual answer, while the other student had to write and submit the final
answer without any feedback from his or her partner (“No Interaction” pattern). Additionally, the inspection of
students’ answers in eCASE revealed that in some cases students were submitting superficial individual answers,
only to make the system promote them to the next step of the script. This pattern of collaboration clearly violates
the ideal script as the instructions were to meaningfully answer the questions and contribute to the effort of the team
through interaction and collaboration.

The degree of self-organization that student teams demonstrated was also affected by their mental script,
that is, the way they understood and interpreted the ideal script (Dillenbourg, 2004). Misconceptions led students to
unpredicted behaviors distant to the script’s goal. For example, student CL2 said:

I was irritated by my partner because she was submitting long and very analytical answers and this
made our answers in the individual phase to differ a lot. I told her to give short answers so that it
would be easier for us to submit a common final answer.

In this student’s mind, agreement between partners was conceived as a script requirement and as a general
goal to submit a common answer, and not necessarily a more complete answer. The examination of the answers of
this dyad showed that the first student was initially submitting comprehensive and good answers, while the other
student was answering poorly in short. During the week, the answers of the first student got significantly shorter and
adequate analysis was often missing. Similarly, students from another dyad said that they intentionally submitted
short final answers to avoid replicating phrases used in their individual answers. This is something that was not
demanded by the script; nevertheless it affected students’ activity.

Lastly, regarding the final answers, only three dyads stated that the final answers were improved in relation
to the respective individual answers. Students felt that the final answers were more eloquent and more complete,
comprising issues raised by either students. On the contrary, students in six dyads said that they did not find
significant differences between their individual and final answers as both analyzed the same issues without a
significant addition, except of a possible improvement on phrasing. The main reason for this was, as students said,
the high level of agreement in the individual answers that resulted to very similar final answers.

Discussion and Conclusions
In this work we have explored two conditions (IL and CSCL) of computer-supported learning, analyzing (a) the
level of individual learning achieved in these conditions and (b) the students’ self-organization patterns in the
collaborative condition. We provided quantitative evidence indicating that there was no significant difference in the
learning outcomes of the two groups (as measured by two specifically constructed instruments). Students in the
CSCL condition did not perform – statistically – any better than those in the IL condition. This outcome should be
discussed in the light of a previous study (Demetriadis et al., 2008) where individually studying students, being
scaffolded by question prompts similar to those presented to the CSCL group, significantly outperformed the control
IL condition. Directly comparing the two studies would be inappropriate due to differences in the treatment of
experimental groups. However, it would be apt to emphasize that while it is possible to achieve higher performance
than the non-scaffolded IL condition, the CSCL scripted approach failed to help students improve likewise their
learning. To analyze possible reasons we focus in the following on CSCL students’ self-organization patterns.
CSCL students’ self-organization affected the script implementation and resulted to a number of actual scripts, ranging from complete conformance (to the ideal script) to violation of script prescription as regards the learner-learner interaction. Based on our qualitative data we argue that three important factors had a major impact on the way that students appropriated the collaboration script.

First, the students’ motivation to engage in shared understanding communication processes during script run-time. Students who enacted actual scripts with low interaction, were less motivated to engage in meaningful interactions and more oriented to finish the activity with minimal effort and in the shortest time possible.

Second, the students’ metacognitive skills and awareness. Students were not familiar with this kind of scripted collaboration and were less skilful in monitoring how their level of understanding would increase through peer interaction. These students considered the learner-learner interaction as a secondary feature of the activity and missed the opportunity to reap learning benefits emerging from this experience.

Third, the design of the script itself. One should not disregard the possibility that the script might not be optimally designed to engage the specific group of students in the process of developing a shared understanding. Students reported that they sometimes perceived discussing with their partners as not necessary since their individual answers to the questions were already converging. This impression eventually rendered the joint effort to reach a shared understanding rather redundant.

Overall, we argue that students’ low motivation, lack of familiarity with the method (therefore, reduced metacognitive awareness about the cognitive benefits emerging from the method) and possible suboptimal script design led certain teams of students to the enactment of actual scripts with low interaction. This, in turn, might have resulted in poor information processing and lower post-test individual performance. We can not, of course, argue that CSCL students would have achieved significantly improved performance in case they would have strictly conformed to script guidance. It seems reasonable to assume that in a situation where all three above factors were improved the students’ level of learning might also have been improved, although this remains to be examined.

Nevertheless, what should be emphasized in this experience are some conclusions of importance to the teacher and CSCL designer. It is clear to us that scripted collaboration can not be considered as a panacea that has the potential to unconditionally heal the shortcomings of free collaboration. The teacher interested in applying the method should be aware of the fact that the interaction of factors such as students’ lack of metacognitive skills, low motivation and suboptimal script design may lead to actual script implementation different to the ideal, that inevitably will undermine the hypothesized pedagogical value of the script. As a remedy for such a situation we suggest that the teacher should beforehand explore students’ prior experience regarding scripted collaborative activities. For inexperienced students the teacher should propose/design a script where the learning mechanism and the emerging peer interaction would be clearly perceived by students as an important and necessary part of the overall activity. Moreover, for low motivated students it seems doubtful whether scripted collaboration can increase their engagement in the collaborative task by means only of cognitive guidance and support. It is suggested that a script can integrate motivational and metacognitive scaffolding as well to stimulate students engage in the process of developing a shared understanding; these components could be adaptively activated depending on the identification (by the CSCL system or the teacher herself) of students’ detrimental self-organization patterns of behaviour.

References


