Facilitating socio-cognitive and socio-emotional monitoring in collaborative learning with a regulation macro script –an exploratory study

Abstract This study examines student teachers' collaborative learning by focusing on socio-cognitive and socio-emotional monitoring processes during more and less active script discussions, as well as the near transfer of monitoring activities in the subsequent task work. The participants of this study were teacher education students whose collaborative learning was supported with a designed regulation macro script during a six weeks environmental science course. The script divided the group work into three phases, namely: the orientation phase, intermediate phase, and reflection phase. The script was put in use by prompting questions that were delivered to the students on tablets. Question prompts instructed groups to plan their collaborative activities, and to stop and reflect on the efficiency of their strategies and outcomes of their learning process. The data were collected by videotaping the groups' face-to-face work and analysed by focusing on verbalised monitoring interactions. More active and less active script discussions were differentiated in terms of the length and the quality of discussion. The results show that the macro script was used more thoroughly at the beginning of the group activities for orientation than for coordinating the progress or reflecting on the performance. Active script discussions involved more monitoring activities, especially providing socio-emotional support. Once socio-emotional support was stimulated in the more active script discussion, it tended to follow-up during the task work. It can be concluded that the groups appropriated the script differently in different situations and with varied success. The implications of facilitating socio-cognitive and socio-emotional monitoring in collaborative learning are discussed.

Keywords Macro-script * Socio-cognitive monitoring * Socio-emotional monitoring * Regulation * Script appropriation * Video analysis

Introduction

Research on collaborative learning has shown that when engaging in deep-level learning, group members coordinate their cognitive, metacognitive, motivational, and emotional efforts, as well as the use of group resources in effective ways (DiDonato 2013; Janssen et al. 2012; Kwon et al. 2014; Saab 2012). This coordination as an intentional and goal-directed activity is defined as group regulation in which students are engaged in the monitoring and controlling of motivation, cognition, and behaviour – in addition to and as a prerequisite for task-level activities, such as knowledge co-construction (Khosa and Volet 2014; Näykki et al., 2017; Rogat and Linnenbrink-Garcia 2011). However, successful regulation is not self-evident in group interaction, and prior research has shown that learners in groups are infrequently aware of their goals, plans, and need for strategies during collaborative interaction (Hadwin et al. 2011; Miller and Hadwin 2015). A lack of skills and missed opportunities for regulating group learning may cause weaker learning processes and outcomes (Näykki et al. 2014; Summers and Volet 2010).

Prior research has suggested that students need scaffolding to engage in, and to progress in, active and effective collaborative learning interactions (Belland et al. 2013; Kirschner et al. 2006). Järvelä and others (2014) emphasise a need for supporting groups' regulation at the cognitive level (i.e. task and content understanding) as well as at the emotional and motivational levels (i.e. goals and interests). Despite a growing consensus on the importance of group regulation within collaborative learning, empirical research on how regulation is enacted during collaborative learning, and how scripting can be used as a scaffold for regulation strategies, is still emergent (Järvelä and Hadwin 2013; Järvelä et al. 2016a).

Previous scripting approaches have studied how scripts can support collaborative learning by specifying the activities that learners are expected to engage in during collaboration (Dillenbourg 2002; Kollar et al. 2006). Typically, scripts have aimed to smooth coordination and to promote high-level collaboration in terms of arguing, explaining and question asking (Fischer et al. 2013). However, there is a lack of studies exploring how to support groups' social regulation strategies (i.e. planning, monitoring and evaluating group working) with pedagogical scripts. Furthermore, prior studies in the context of computer-supported collaborative learning (CSCL) have mostly operationalised effective collaborative interaction either from the socio-cognitive or socio-emotional points of view (Ludvigsen 2016). This type of approach yields a narrow view of effective collaborative learning and lacks the opportunity to explore and explain the interaction and support systems among various facets of collaboration (i.e. behavioural, cognitive, and emotional) (Ryu and Lombardi 2015).

In addition to specifying what effective collaborative learning is, what aspects and processes it contains, and how it could best be supported, one emergent topic in the collaborative learning research is how to increase students' transferable skills of collaborative learning. . Particularly, the current interest is in the question of *appropriation* of collaborative learning scripts (Tchounikine 2016) that is defined as group members' perception, interpretation, and implementation of the script (Stegmann et al. 2016). However, there is a lack of empirical research on how learners appropriate and implement scripted processes in new learning situations.

Our research focuses on interactions from both socio-cognitive and socio-emotional points of view and particularly explores group regulation in terms of socio-cognitive and socio-emotional monitoring. This approach follows Järvelä and colleagues' (2016) work on collaborative learning by considering group processes as a temporally evolving rather than state-like phenomenon. In this paper, we examine a designed macro-script for effective collaborative learning. We focus particularly on when and how forms of socio-cognitive and socio-emotional monitoring emerge and function during scripted collaborative inquiry learning in a student teachers' environmental science course. We also extend the approach to explore how monitoring processes emerge in the task work that follows the scripted phases.

Scaffolding collaborative learning by scripting and prompting

In their seminal paper, Wood, Bruner, and Ross (1976) explored how adults help infants' problem solving and found that adults did not directly tell or demonstrate how to solve the problem, but rather scaffolded the children. Wood and colleagues (1976, p. 98) noted how adults used the following six strategies to support children's effort until they gained sufficient skills: "recruitment, reduction in degrees of freedom, direction maintenance, marking critical features, frustration control, and demonstration". Actually, as Belland, Kim, and Hannafin (2013) highlight, three of the six original scaffolding strategies that Wood and colleagues (1976) introduced are motivational (recruitment, direction maintenance, and frustration control), and the other three are cognitive (reduction in degrees of freedom, marking critical features, and demonstration). Thus, scaffolding in its original sense was equally focused on motivational and cognitive support.

Building on the scripted cooperation approach (O'Donnell and King 1999; O'Donnell and Dansereau 1992), scripts support collaborative processes by specifying, sequencing, and distributing the activities that learners are expected to engage in during collaboration (Dillenbourg 2002; Kollar et al. 2006). Collaboration scripts are designed to shape the way students interact with each other and to engage them in specific activities and discourse moves that are associated with high-level collaborative learning (Dillenbourg 2002). Overall,

collaboration scripts provide explicit guidelines for small groups to clarify what, when, and by whom certain activities need to be executed (Weinberger et al. 2007).

Scripts vary widely in terms the objectives, methods of delivery, and the types of activities they support (Kobbe et al. 2007). Scripts typically aim to smooth coordination and communication, but there are also scripts that aim to promote high-level socio-cognitive activities (e.g. explaining, arguing, and question asking) (Fischer et al. 2013). Furthermore, collaboration scripts have often been realised through prompts that can take the form of sentence starters or question stems (Ge and Land 2004) to provide learners with guidelines, hints, and suggestions that facilitate the enactment of scripts (Weinberger et al. 2007).

The research on CSCL scripts broadly distinguishes between two types of scripts – micro and macro scripts – based on the level of granularity at which they support learners. Specifically, micro scripts consist of, for example, sentence openers that prompt learners to contribute domain content to the discussion and critique one another's contributions (i.e. Weinberger et al. 2005). Macro scripts support collaboration more broadly by orchestrating activities and processes expected to enhance collaborative learning and typically do not provide detailed support on how to enact these activities (Dillenbourg and Hong 2008; Dillenbourg and Tchounikine 2007; Hämäläinen and Häkkinen 2010). For instance, the classical example of Jermann and Dillenbourg's (2003) ArgueGraph macro script specifies and sequences general phases in a classroom argumentation task.

A recent meta-analysis of scripting (Vogel et al. 2016) shows that learning with scripts can lead to a small positive effect on domain-specific knowledge and a large positive effect on collaboration skills compared to unstructured collaborative learning. Vogel and others (2016) further reveal that scripting is particularly effective when it is combined with additional content-specific tools (i.e. worked examples and concept maps). Also, Järvelä and others (2014) highlight the possibilities for supporting collaborative learning with (1) scripting, (2) prompting, and (3) utilising technological tools in collaborative inquiry tasks. In this study, we contribute to the CSCL literature by scripting a combination of socio-cognitive and socio-emotional group activities that characterise well-functioning and effective collaborative learning.

Cognitive design principle: socio-cognitive monitoring

Socio-cognitive monitoring involves evaluating and judging one's own and each other's understanding, cognitive functioning, and progress during the group task (Goos et al. 2002; Näykki et al. 2017). Through monitoring processes, the group members may become aware of their own and each other's learning and understanding of the content as well as situation-specific skills required for successful group activity (e.g. De Backer et al. 2014; DiDonato 2013; Khosa and Volet 2014; Rogat and Linnenbrink-Garcia 2011). Previous studies have shown

that groups where learners monitor their own and their peers' thinking and understanding have been shown to engage in deeper-level learning processes compared to groups in which understanding is not actively monitored (Goos et al. 2002; Hurme et al. 2006; Iiskala et al. 2011; Lee et al. 2015; Näykki et al. 2017). For example, Roscoe and Chi (2008) evaluated events where explaining one's own understanding by using monitoring statements, such as "I didn't understand this before", was useful for making new connections and building understanding at the group level. Recent findings from our own study (Näykki, et al. 2017) as well as from Lee and colleagues' study (2015) are related to the cognitive design principle by indicating that monitoring thinking and understanding plays a key role in high-quality engagement in a joint activity. Our previous study specifies that monitoring functions in parallel with knowledge co-construction, and it activates episodes of higher-level questions and answers (Näykki et al. 2017).

The basic assumption in regard to how scripting can support collaborative learning is that it is designed to guide students in performing meaningful and beneficial learning activities. These may result in positive learning outcomes with respect to domain-specific knowledge and collaboration skills (King 2007). Prototypical examples that have been supported with scripting are reciprocal questioning and explaining, creating, and sharing external representations of knowledge, as well as engaging in discursive learning activities (King 1992; Webb et al. 2009). Webb with colleagues (2009), for instance, reported in their study about elementary school students' algebraic problem solving that the collaborative activity of giving explanations during small group learning dialogue was positively related to domain-specific learning outcomes. Teasley (1997) pointed out the importance of other-oriented transactive activities. The most important characteristic of these transactive activities was to take the learning partners' contributions into account (e.g. by criticising, refining, or extending these contributions). A similar finding was also evident in our previous work (Näykki and Järvelä 2008), where the most effective student groups were engaged in transactive learning activities by extending each other's ideas and contributions.

In all these examples, the processes of socio-cognitive monitoring are implicitly important for effective collaborative learning; monitoring is needed to control and modify the groups' shared learning processes. However, none of the earlier studies have explicitly focused on supporting socio-cognitive monitoring. Järvelä with colleagues (2016) argue that one of the challenges in acquiring deep-level knowledge construction in a collaborative setting is the fact that students in groups are not engaged in self-regulating their own learning processes or those of their peers. Thus, this study highlights the need for focusing on students' success in increasing awareness of socio-cognitive monitoring and the productive adaptation of their learning behaviours to their situated learning challenges (Järvenoja et al. 2015; Näykki et al. 2014). We posit that designing a scripting approach to enhancing socio-cognitive monitoring may increase students' awareness of their

own learning and that of others and should therefore increase the effectiveness and efficiency of learning processes and learning outcomes.

Emotional design principle: socio-emotional monitoring

Collaborative learning involves behavioural and cognitive operations, but also central to the success of collaborative learning is how learners feel and manifest their own feelings in the learning situation – what kinds of negative or positive emotional reactions are aroused before, during, and after the group task (Baker et al. 2013)? Students in academic learning settings (such as group tasks) frequently experience emotions such as enjoyement of learning, hope for success, pride in accomplishments, anger about task demands, fear of failing, or boredom (Pekrun et al. 2002). More specifically, both negative and positive affective states and emotions experienced within the group can derive from a variety of factors – from personality differences to the dynamics and processes created within the collaborative group (Järvenoja and Järvelä 2009; Näykki et al. 2014; Van Den Bossche et al. 2006; Volet and Mansfield 2006). In general, emotions can be defined as intense reactions that are usually generated by a process of appraisal of the situation or dispositions that are transferred to the situation (Frijda 1986; Lazarus 1991).

Research has shown that both positive and negative emotional states consume attentional resources by focusing attention on the object of emotion (Ellis and Ashbrook 1988). Overconsumption of attentional resources implies that fewer resources are available for task completion, thereby having a negative impact on performance (Meinhardt and Pekrun 2003). Thus, emotion regulation as a goal-directed process of influencing the intensity, duration, and type of emotion experienced (Jacobs and Gross 2014) is needed for successful learning in individual as well as in group settings. The recent research on group emotions has shown that emotional experiences and expressions of emotions can be monitored, controlled and directed (Järvenoja and Järvelä 2009; Näykki et al. 2014) and socio-emotional monitoring is one of the main regulation processes for successful collaborative learning (Kwon et al. 2014; Lajoie et al. 2015; Rogat and Linnenbrink-Garcia 2011; Ucan and Webb 2015).

Emotion regulation in collaborative learning refers to the process involved in becoming aware of one's own and others' affective reactions and having the ability to monitor and control emotional experiences to modify or temper aspects of emotional experiences (particularly when they interfere with the group's goals and with social interaction) (Boekaerts 2011; Schutz and Davis 2000; Thompson et al. 2003; Wolters 2003). An inability to increase or decrease the intensity and duration of emotional arousal can hinder performance and interpersonal relationships, whereas the capacity to temper emotions facilitates functioning in social and academic contexts (Boekaerts 2011).

In fact, socio-emotional monitoring can be seen as a diverse set of strategies influencing which emotions are experienced, when and how they are experienced, and how they are communicated within group interaction. Monitoring and the use of diverse control processes does not mean that emotions should not be experienced and/or verbalised within group interaction. On the contrary, the expression of emotions is a sign of socio-emotional engagement and can function towards effective collaborative interaction (Näykki et al. 2014). What is important for well-functioning group interaction, is how emotions are expressed and interpreted within group situations. When emotional reactions emerge, their interpretation can be positive and thus lead to increased engagement and efforts in group activities; alternatively, it can be negative and lead to disengagement and withdrawal from the group and its activities (Linnenbrink-Garcia et al. 2011; Näykki et al. 2014).

What is missing in the scripting and scaffolding literature of collaborative learning is emotion regulation support at the individual and group levels of collaboration (Järvelä et al. 2016). These can mean, for example, tools and scaffolds for making group members' feelings and intentions visible so the group can mirror its processes. This is important to be able to modify the group processes when, for example, emotional experiences implicitly but negatively affect the group interaction and learning (Linnenbrink-Garcia et al. 2011; Näykki et al. 2014).

We agree with Ludvigsen (2016) that emotions play an important role in collaborative learning, and thus, more research is needed to understand how emotions contribute to and are co-constituted with the cognitive and social aspects of group interaction in CSCL. This study characterises and operationalises effective collaborative learning as a multidimensional process of socio-cognitive and socio-emotional interactions. Socio-cognitive monitoring in this study targets mindful and strategic activities related to students' own and each other's content understandings and monitoring possible content-related misunderstandings in an interpersonal level. Socio-emotional monitoring is defined as how each participant in a group monitors their own and others' emotions and what type of interactions they engage in about their emotions or providing socio-emotional support within the group (Kempler Rogat and Linnenbrink-Garcia 2011; Näykki et al. 2014; Rogat and Adams-Wiggins 2014). We, thus, posit that the socio-emotional aspects of collaboration are central in successful collaborative learning (Andriessen et al. 2013; Järvelä et al. 2013).

Appropriating scripts and transferring scripted activities

According to the study by Hämäläinen and Häkkinen (2010), learners may make use of a given script more ideally or less ideally. This relates to the question of how scripted activities are actually enacted in different learning situations. The *appropriation* of scripts is a current topic of discussion in CSCL scripting research. Tchounikine (2016) introduced the question of appropriation of scripts by

emphasising the need to understand how learners perceive, understand and make the script their own. Stegmann, Kollar, Weinberger, and Fischer (2016) replied to this request by emphasising the meaning of individuals' perception, interpretation, and implementation of scripts. These researchers highlight that collaborative scripts are understood and enacted differently by different groups of students. How students enact the script varies on the basis of a complex set of intertwining factors, such as students' goals and other situational characteristics (Tchounikine 2016). This further influences how scripted activities are internalised and, thus, have the possibility to influence collaborative learning situations (Stegmann et al. 2016).

So far, there is a shortage of empirical studies showing the variety of how scripted activities in collaborative learning are actually enacted and how such activities are reflected in a subsequent unscripted collaborative learning. The latter question relates to the notion of *transfer*. The transfer literature has long sought to identify possible ways to develop general cognitive skills, i.e. thinking skills and problem-solving skills that would be applicable across contexts (i.e. Adey and Shayer 1993; Berry 1983; Georghiades 2000; Halpern 1998; Osman 2008). For example, Kalyuga (2009) demonstrates that appropriate instructional support and optimal levels of control over the learning processes may enhance learners' abilities to transfer their knowledge and skills. Because the goal of introducing CSCL scripts is to improve the internalisation of scripted activities (Fischer et al. 2013), the transfer of scripted activities to unscripted interaction is naturally an interesting consideration. However, while it is known that CSCL scripts can enhance collaborative learning compared to unscripted collaboration (Vogel et al. 2016), empirical studies depicting the enactment of scripted activities and the near or far transfer effect of scripted interaction is scarce.

Research questions

The aim of this study is to examine student teachers' collaborative learning by focusing on both the socio-cognitive and socio-emotional monitoring activities during more and less active scripted interaction as well as the near transfer of socio-cognitive and socio-emotional monitoring activities in the subsequent task work. The particular research questions are as follows: 1) How do socio-cognitive and socio-emotional monitoring emerge in the situations where the provided script is used more actively and less actively? 2) How do socio-cognitive and socio-emotional monitoring activities transfer to subsequent task work after more active and less active script discussions?

Methods

Context and participants

The study was conducted in a Finnish University in a first year teacher education course about environmental science. During the six-week course, the students (N = 19, M_{age} = 23 years, 12 women and 7 men) worked on five face-to-face collaborative tasks. The mixed-gender groups of three to four students were formed based on pre-questionnaire responses which assessed students' dispositions towards collaboration (Wang, 2009). The Likert-scaled items included measures such as "I enjoy exchanging thoughts" and "I am open to all sorts of opinions". Based on their answers, students were divided into three profiles: students who were the most positive towards collaboration, students who were the least positive towards collaboration, and students who were in-between. Groups were formed so that each group included students from all three profiles.

Procedure

The groups were assigned to work on technology-enhanced tasks about five environmental science topics: Species, Eco Systems, Maps, Planetary Phenomena, and Climate. The teacher of the course planned the collaborative activities together with the first and the second author of this article. In each 90-minute lesson, the teacher first introduced the topic and aimed to increase interest towards it. The following group tasks required students to discuss a specific topic and collaboratively design tasks for teaching the topics in elementary school. The pedagogical design tasks are at the core of Finnish teacher education. The teacher education students are taught to improve their pedagogical knowledge and skills while learning the subject matter. During these tasks, the students worked with content and phenomena they were familiar with based on their previous education and courses. They also had access to the various material sources where they could search for information if they were lacking knowledge of the topic. The students were asked to take advantage of provided materials, such as handouts and books, and the students were also encouraged to use laptops and tablets for searching for further information, documenting their task products, and sharing their products online with other groups.

The goal of the tasks was to enhance students' conceptual and pedagogical understanding of given concepts and phenomena in environmental science. The open-ended tasks required students to activate prior knowledge, to negotiate their understandings, to evaluate the relevance of various environmental science topics for children, and to jointly design effective pedagogical methods for teaching the topics in elementary school. To give an example of one of the tasks, the following instructions were given for the collaborative task about weather and climate:

Choose a weather-related phenomenon based on your interests. 1. Discuss and plan how you would teach and illustrate the chosen phenomenon using a whiteboard or interactive board. Choose a grade and the goals of teaching. Discuss: How would you involve the pupils? What kind of information is relevant for the pupils? How would you present the information? Design a visualisation of the chosen phenomenon. Look for information online. 2. Design a task for pupils about the chosen phenomenon. Consider the age of the pupils and your teaching goals. Discuss how to integrate other subjects. Save your plan online in the shared folder.

Following each collaborative session, the students participated in a whole-class discussion where they were encouraged to explain and extend their understanding of the scientific concepts and topics. The data and analyses presented in this article are focused on the small-group collaborative activities.

A macro script for regulated learning

The work in the student groups was supported with a designed macro script that implemented the cyclical idea of regulated learning (Zimmerman, 1989; Cleary and Zimmerman, 2012). The script was divided into three phases. It started with orienting whereby groups set goals and plans for their learning (orientation phase), continued with progress coordination (intermediate phase), and ended with reflection on the process and performance (reflection phase). In addition to dividing the group work into different phases, specific questions were prepared to prompt groups' socio-cognitive and socio-emotional monitoring (see Table 1). The script included prompting questions that were delivered to the students with tablets, which were also used as information-seeking and sharing tools during the collaborative group work. Question prompts instructed groups to stop and reflect on their thoughts and feelings and to consider the efficiency of their group interaction. These question prompts were designed by taking into account learning processes that characterise effective regulation in collaborative learning interaction (Hadwin, Järvelä, and Miller, 2011). Specifically, the orientation phase focused on assisting groups' planning processes by activating task understanding, prior knowledge, efficacy beliefs, and goal setting; the intermediate phase's prompting question highlighted monitoring progress towards goals, and challenge awareness; and the reflection phase asked groups to concentrate on performance evaluation and challenge awareness.

Table 1. Script questions in three script phases

Data collection and data analysis procedures

The exploratory study was conducted in a classroom-like research space (http://www.oulu.fi/leaf-eng/) by using video tracks with a spherical 360-degree point of view. The five student groups were recorded five times (30 h of video

data). The setting made it possible to record all the groups at once, and videos captured the students' discussions, movements, and gestures. Because students' participation in group activities was not obligatory in this course, some students were absent from some of the sessions. We selected those group sessions for the analysis where a minimum of three group members were present. This selection criterion excluded pair work from the study. After excluding videos with student absences, 20 videos (M_{duration} = 1 h 9 min) were analysed. Thus we had three to five sessions for each group.

A multi-step analysis method was used to explore when and how processes of socio-cognitive and socio-emotional monitoring emerged and functioned during scripted and nonscripted collaborative learning. QSR International nVivo 10 data analysis software was used for the coding of the videos with time-logged codes, and the generated frequencies and durations were exported to the SPSS software for further analysis (i.e. Kruskall-Wallis test and Mann-Whitney test). First, the video data were segmented into 30-second events. The time-based segmentation of events gave a structured and consistent unit for analysis and allowed a temporally unfolding overview of the group situations (Miles and Huberman 1994; Sinha et al. 2015). Time-based coding reduced the challenges related to pinpointing the exact second of the beginning or end of the observed phenomenon. Using segments as units of analysis was considered a sufficient means of providing the timing of the coding categories within the 30-second timeframe. The timeframe of 30 seconds was chosen, because it was long enough to observe several conversational turns but short enough to make detailed and moment-by-moment observations.

Each 30-second segment was first briefly annotated with a description of what had occurred within the episode, such as, "The group finishes their first task. Emma shows the created mind map to others. The group discusses whether they have justified their task sufficiently. Vilho suggests that the group moves on to their second task". These annotations created a rough content log of each video. The content log was complemented with a short memo of the most salient observations of each video. Second, each 30-second event was observed to see if the group members showed socio-cognitive and socio-emotional monitoring (see Table 2). The event was coded if it met the criteria for a code. The implemented coding categories were not considered mutually exclusive; instead, it was assumed that different monitoring strategies could exist parallel to each other, and thus, the same 30-second event could be coded under more than one category. This possibility for overlapping is based on the assumption that group interaction reflects both socio-cognitive and socio-emotional aspects of learning (Kreijns et al. 2003). In those situations that included overlapping of the coding categories, the groups, for example, expressed positive or negative emotions while they simultaneously discussed cognitive challenges and/or monitored task progress.

The coding categories and overall coding protocol were developed in several phases. First, prior to viewing the videos, a list of preliminary areas of interest was

developed according to the stated research questions. Second, the coding protocol was developed and elaborated further after viewing the videos several times. Third, the preliminary coding categories were compared to previous research of sub-processes in social regulation (i.e. DiDonato 2013; Khosa and Volet 2014; Kwon et al. 2014; Lajoie et al. 2015; Lee et al. 2015; Näykki et al. 2017; Rogat and Linnenbrink-Garcia 2011; Saab 2012; Ucan and Webb 2015), and finally, coding sub-categories of socio-cognitive and socio-emotional monitoring were formulated and tested several times. This involved the reorganisation and renaming of categories as well as specifying subcodes and providing examples of the specified categories.

The final version of the coding protocol included the following main categories and subcategories: 1) socio-cognitive monitoring (subcategories: monitoring task understanding, monitoring content understanding, monitoring task progress, and monitoring socio-cognitive challenges) and 2) socio-emotional monitoring (subcategories: monitoring socio-emotional experiences, monitoring socio-emotional challenges, and providing socio-emotional support within group interactions). These monitoring strategies were considered to reflect how group members in different task phases and situations were attentive and focused on effective collaborative learning interaction. The specific coding rules and examples of the analysis are presented in Table 2.

Table 2. Coding categories, Kappa coefficient and data examples

The reliability of the coding was assured by selecting 25% of the video data to be classified by the independent coder. The first and second authors were responsible for the coding; they both participated in the refinement of the coding system and, while coding, were blind to the performance of the students. Reliability analysis was used to refine the coding scheme and the analysis. All the data were analysed by the first author of this article, and 25% of the data were used in intercoder reliability analysis by the second author. Cohen's kappa coefficient was selected as a statistical measure for evaluating an inter-rater agreement for qualitative items. It is generally thought to be a more robust measure than simple percent agreement calculation, since it takes into account the possibility of agreement by chance. Cohen's kappa showed a good reliability of the coding for all the categories. The first intercoder reliability values varied from 0.65-0.76. Next, meaning making discussions were held and disagreements were negotiated and resolved. The second round of intercoder reliability analysis gave Cohen's kappa values between 0.76-0.95. The qualitatively analysed interaction data were quantified (based on durations) to detect possible differences between groups and tasks (Chi, 1997; Strijbos, Martens, Prins, and Jochems, 2006).

Further analysis explored how these analysed processes were enacted in different phases of the script (i.e. orientation-, intermediate-, and reflection-phase) and during the following task work. The durations and qualitative characteristics of the scripted discussions were considered. The groups self-determined how

thoroughly they discussed the provided prompt questions and decided when they were ready to continue with their task work. Therefore, the group situations differed in terms of duration of the script discussions as well as the focus and the quality of the discussions. In some of the groups, the provided external support was used more thoroughly and each prompted question was discussed carefully, whereas some script situations were weaker in terms of the time devoted and content provided by the groups. Thus, the group situations were referred to either as a more active (> $M_{duration}$ and high quality) or less active (< $M_{duration}$ and low quality) script discussion. Table 3 presents the criteria for the qualitative evaluation of the script discussions. None of the script discussions were short and high-quality or lengthy and low-quality. This study focused on 20 collaborative situations of which nine situations were regarded as more active script situations, and 11 situations were characterised as less active script situations ($M_{duration}$ = 0:07:31, *SD* 0:02:57).

Table 3. Quality of script discussion

As this study is strongly exploratory, the qualitative examples were described in detail to illustrate and broaden the perspective of the quantified analysis. The qualitative examples were selected from the data to show what types of discussions were activated with scripted discussion and what kinds of qualitative differences could be seen in different learning situations. The case examples were selected based on the following selection criteria. At first, the most active group working session in terms of the script use was selected (namely, the second task of group 5, where the duration of the script discussion was 13 minutes). Second, the parallel but least active group session was selected (namely, second task of group 3, with a script discussion duration of 5 minutes). The two extremes were selected as case examples, because they clearly illustrate the differences between situations with more and less active script use. On average, the script discussion length in the whole dataset was 7 minutes per task. All the groups had more and less active script discussions (see Table 4 for the overall minimum and maximum script discussion durations in different groups).

Table 4. Script discussion durations among the collaborative learning groups

Results

Preliminary analysis: macro script use

The average overall duration of the groups' scripted discussions per session was 0:07:31 (*SD* 0:01:29, *min* = 0:01:59 and *max* = 0:13:00). On average, the groups used more time for the orientation-phase (*M* = 0:03:03, *SD* = 0:01:14, 4.50% of their total group working time) than for the intermediate-phase (*M* = 0:02:16, *SD* 0:01:29, 3.32% of total group working time) or the reflection-phase (*M* = 0:02:12,

SD 0:01:12, 3.17% of total group working time) (Table 5). This shows that the groups spent more time orienting themselves to the group work than for coordinating their progress within the task or reflecting on their learning and group work in the end of their task work.

Table 5. Durations of the scripted phases

The results show that the type of monitoring varied during the scripted phases (Table 6). The Kruskal-Wallis test showed that the amount of groups' monitoring of socio-emotional experiences (as a sub-category for socio-emotional monitoring) differed significantly in the different script phases ($H(2) = 14{,}18$, $p < .01$), with a mean rank of 42.30 for the orientation phase, 25.50 for the intermediate phase, and 23.70 for the reflection phase. Pairwise comparisons (post-hoc tests) showed significant differences between orientation and intermediate phase and between orientation and reflection phase ($p < .01$, respectively). A Kruskal-Wallis test also showed that the groups' monitoring task understanding (as a sub-category for socio-cognitive monitoring) differed significantly in the script phases ($H(2) = 24{,}88$, $p < .01$), with a mean rank of 45.98 for the orientation phase, 23.28 for intermediate phase, and 22.25 for the reflection phase. Pairwise comparisons (post-hoc tests) showed significant differences between the orientation and intermediate-phase and between the orientation and reflection-phase ($p < .01$, respectively). As expected, the script directed the groups to focus on monitoring task progress more in the intermediate-phase than in the other scripted phases. There were no significant differences between phases in other categories. However, it is notable that the socio-emotional activity of "providing socio-emotional support" was the only type of monitoring activity that was frequently present in all script phases, and the amount of it slightly increased from the orientation phase to the reflection phase.

Table 6. The number of monitoring activities in the different scripted phases

How do socio-cognitive and socio-emotional monitoring emerge in the situations where the provided script is used more actively and less actively?

The more active and less active script discussions were explored in terms of different types of monitoring activities that were stimulated. When the mean durations of monitoring were compared, the results showed that there were differences between the amount of monitoring activities that active script discussion stimulated compared to the less active script discussions. The overall difference among all the group situations was highest in terms of monitoring socio-emotional support, where the mean duration in the more active script discussions was 4.33 minutes, while the mean duration in the less active script discussions was 2.09 minutes (Table 7). However, smaller differences were also seen across all types of monitoring.

Table 7. The mean duration of monitoring activities during more active and less active script discussions

To explore in more detail the monitoring processes that the script stimulated, the most active script discussion was selected (Group 5, task 2) and compared with the least active script discussion during the parallel task (Group 3, task 2). The groups' actions for socio-cognitive and socio-emotional monitoring in different script phases are elaborated through the transcribed examples. Figure 1 gives an example of two case groups' orientation, intermediate and reflection script discussions. Case 1 shows an active script discussion and Case 2, in contrast, shows a group situation where the short script discussion involves few monitoring activities.

Figure 1. Socio-cognitive and socio-emotional monitoring during more active and less active script phases

In the first transcribed example, the case groups are discussing the orientation script questions. The left column in Table 8 shows an active script discussion during a collaborative task about forest ecosystems, whereas the right column shows the same question prompt in the same task in a less active script discussion. The example shows how the Case 1 group was engaged in socio-cognitive and socio-emotional monitoring when discussing their strengths as a group. This example highlights what type of norms the group members created for their group work. For example, the group discussed how important it is to share ideas, to state their opinions, to give space for everyone to contribute, and to have a mindset of learning from each other's' ideas and points of view. They also started to monitor their content understanding with Anna (note that all the names are pseudonyms to protect students' privacy) explicitly emphasising the pursuit to gain a better understanding of their topic through collaboration (line 8): "We want to learn from each other. For me it is important to learn from you, because I don't have a lot of previous knowledge of these things". Niina continued by highlighting the opportunity for shared learning by saying (line 9): "Maybe together we can find new things. I hope that we can put our knowledge together, and we can all learn from it". This discussion shows how the group members explicated interdependency and built a safe socio-emotional atmosphere for collaboration. Particularly important from a socio-emotional point of view is that they explicitly state that they want to learn from one another. These are regarded as valuable discussion acts for developing a socio-emotionally well-balanced group situation. In other words, these group members show that they value each other's contributions and that they also see this group situation's learning value. The second example on the right-hand column in Table 5 shows how the Case 2 group discussed the same script question. Even though they also explicated a good socio-emotional atmosphere, their discussion was short, and it stayed on the surface level. They did not, for example, engage in discussions where they would build group norms or values.

Table 8. Transcribed example of the orientation-script discussion

The second pair of examples (Table 9) is from the groups' intermediate script discussion that was conducted about half-way through the group task. The Case 1 group focused first on the socio-cognitive monitoring of their progress by summarising what content they had covered so far. They also monitored their content understanding and specified in which parts they lacked understanding. The continued discussion shows their socio-emotional monitoring in terms of expressing the value of group work in situations where they lack understanding or where they have different types of understanding. Niina explicitly highlights the importance of group interaction (line 8): "I think it is a good thing in group work that we have different opinions, but we also need to justify those opinions, so we need to really think what our understanding is and why we think something is important". Iida says (line 10) that she thinks that they were having challenges in the beginning, but now she feels that the task is clearer. Niina continues (line 11) by showing how she values the task and sees it as important for their future work as classroom teachers. Iida specifies (line 4) that she feels good about working on this task together as a group. This example shows how, and particularly how often, the scripted working phase afforded the group socio-emotional monitoring in terms of discussing the task value as well as their progress as a group. This discussion demonstrates that the group members were aware that they had different understandings and opinions, and they understood that they were needed to justify their opinions. They regarded their group work as valuable especially because of the opportunity to have more opinions and suggestions than only one's own. This example highlights a deep-level understanding of group interaction and illustrates how cognitive aspects (developing understanding) are intertwined with socio-emotional aspects (interdependency, value of group work). In contrast, the Case 2 group replied to the same script question briefly by Alisa saying: "This is quite tiring work. It is because of these early mornings". This shows a surface-level approach to the monitoring of the group's progress, on both a socio-cognitive as well as a socio-emotional level.

Table 9. Transcribed example of the intermediate-script discussion

The last scripted-phase, reflection, requested the groups to engage in an evaluation of how they succeeded in the task as a group, what types of challenges they experienced, and how they overcame the possible challenges (Table 10). The Case 1 group considered time management as a challenge for them. However, their discussion also implies that they needed to make compromises in their work, and they discuss why compromises are important in the group interaction as well as in teachers' work. This example shows a proficient type of monitoring, where group members are able to reflect on what types of behaviour were successful within the group interaction (line 3), but they also extend their thinking towards future work as classroom teachers (line 5). For the Case 1 group, the most visible aspect that supported their group work was their ability to make compromises but also that they were aware of their need for compromises. This last example is shown in their

reflection-script discussion, where they again point out that they were able to make compromises and take others' thinking into consideration. This shows an example of the socio-emotional support provided in this group as well as their group working values. In contrast, the Case 2 group with less active script discussion felt that their group work was challenged, because they were tired, and they were not able to overcome that challenge during their work. Thus, the discussion stayed on a superficial level and lacked true reflection and evaluation.

Table 10. Transcribed example of the reflection-script discussion

How do socio-cognitive and socio-emotional monitoring activities transfer to the subsequent task work after the more active and less active script discussions?

The results indicated the differences between the group situations in terms of socio-cognitive and socio-emotional monitoring during scripted discussions. Further analysis aimed to explore whether there were also differences in groups' socio-cognitive and socio-emotional monitoring after more active and less active script discussions. In other words, we examined how the supported monitoring activities were transferred to the task work phases. This was done to evaluate whether the active script use also contributed beneficially to the groups' task work. Based on a Mann-Whitney test, the situations in which the groups were actively and less-actively using the script for their group work differed significantly from each other in the task work phase. The difference was significant in regard to how the groups provided socio-emotional support (as a subcategory for socio-emotional monitoring) during the task work ($U = 79.50$, $p = .020$) with a mean rank of 7.77 (for less active script use) and 13.83 (for more active script use). In other words, socio-emotional monitoring in the form of providing socio-emotional support was more often transferred to task work after more active script discussion than after less active script discussion (Figure 2). Other types of activities, including main and sub-categories, were not significantly different in the learning situations where groups were more active or less active in their script use.

Figure 2. Transfer of socio-emotional support to task working after more active and less active script discussions

The Case 1 group was engaged during the script discussions in building up a sound socio-emotional atmosphere, which was explained in detail during the previous section. The Case 1 group also put forth effort to keep up the socio-emotionally balanced atmosphere by providing socio-emotional support during their task work (i.e. by giving attention to each other's contributions, by being aware of the need for compromises, and by being able to make compromises). This was visible when they verbalised their arguments and made joint decisions, such as: "it is true what you said earlier" and "you can do what you consider is the best". These were also present in this group's scripted discussions when the group members highlighted the importance of interaction and the meaning of

compromises. The Case 2 group, in contrast, did not explicate the meaning of a group's socio-emotional support in their script discussions nor during their task work. There were a few attempts to provide socio-emotional support during their task work, but there were short compliments, such as: "good point" and "it's quite well written".

The following transcribed examples show the observed differences in the case groups' interaction and the types of socio-emotional support provided after the more active and less active script discussions. The first transcribed example is from the task work phase where the Case 1 group is coming to a solution in their task. Earlier, this group had some differing opinions about the topic, and this episode shows how they came to a shared solution and how they provided socio-emotional support to each other. Interestingly, a clear connection can also be seen in this conversation to their scripted phase discussions. The most visible theme in this group's scripted discussions was how they were first building a safe socio-emotional climate for their group work and how they valued their group's ability to make compromises. This transcribed example shows socio-emotional support and how particularly Niina (line 7) acknowledges an earlier contribution by another student, Anna, by saying: "...but it is true what you said earlier (looking at and waving her hand towards Anna) that we are planning this class session for the 4th graders, so it could be more challenging". This selected example shows that this group has been negotiating their understanding and also making compromises. In this example, it becomes clear that Niina is trying to smooth the conversation by explicitly stating to Anna that her point was also correct, even though they as a group decided not to follow her opinion. A small amount of emotional arousal in terms of frustration can be seen from Anna's behaviour and her wording when she says (line 4): "No no that's not what I meant" and (line 13) "Ok, sorry [for asking]". However, it can be concluded that in this group situation Niina pointed out that she values Anna's point of view and it worked as a socio-emotional support for the whole group, but particularly for Anna.

Table 11. Transcribed example of socio-emotional support

The second example from the Case 1 group (Table 12) is at the end of their task work. In this episode, Anna is giving a suggestion for their group work (line 1): "Should we write examples of organic and inorganic?" Niina replies and shows a different opinion – that of not wanting to write more detailed information. She reasons her suggestion by saying that they do not need to be so specific. Anna points out that she disagrees (line 6): "but I think we should write down all we know". The accompanying smile makes the disagreement less direct. At this point, Niina laughs and moves closer to see what Iida has written. Niina says (line 7): "You can write it down". However, Anna withdraws her suggestion by saying (line 8): "No you don't need to write it because of me, no problem". After Anna has withdrawn her suggestion, she turns her gaze away from the group for a moment. Iida summarises what she has written. Anna says (line 10): "You can write what

you consider is the best solution". Niina shows socio-emotional support by saying (line 11) that she understands Anna's point of view but also feels that it is challenging for them to progress the way Anna is suggesting, since they are now in a hurry to finalise their task. At the end of this episode, the group members decide not to include the examples (lines 12-13).

Table 12. Transcribed example of socio-emotional support

The Case 2 group did not challenge each other's thinking in any of the phases of their group work like the Case 1 group did. They also had fewer instances where they provided socio-emotional support for each other (see Figure 2). The selected transcribed example (Table 13) offers a discussion typical of this group. In the example, Sara explains her content understanding of the forest ecosystem. Alisa acknowledges Sara's point by saying (line 2): "That is a good point, definitely that is valuable to notice". The short episode continues by Elias summarising what he had written down, and Alisa shows nonverbal socio-emotional support by showing a thumbs up. Elias is not very keen toward this nonverbal support and says (line 5): "This is just bullshit". Alisa replies by praising Elias (line 6): "no, I think that is quite well written". It can be concluded that, in this case example, the socio-emotional support was targeted directly at the group members' current activities, for example, at what they were saying or writing about the content. Furthermore, no specific transfer can be seen in this group's scripted discussion and task discussion, where they would have been elaborating their work and providing socio-emotional support.

Table 13. Transcribed example of socio-emotional support

Summary of the selected case examples

The transcribed case examples described above show the situational differences of the socio-emotional support given in each case group. It can be summarised that in the Case 1 group, the group members challenged their own and each other's thinking more and thus also needed different types of socio-emotional support to keep their group work well-balanced. The Case 1 group's interaction also showed the transfer between scripted phases and task work phases. Their scripted discussions included themes like valuing group work, valuing each other's contributions, and valuing the ability to make compromises. These themes also became visible in their task work phase through the socio-emotional support they provided. On the other hand, the Case 2 group's socio-emotional support was more directly targeting the current activities in the group – for example, by praising the contributions of the other group members. No thematic connection could be found between this group's script and task work phases.

Discussion

This study explored collaborative learning in terms of groups' socio-cognitive and socio-emotional monitoring. A regulation macro script was implemented to support groups' interaction and working processes. The study focused on monitoring activities during more and less active scripted interaction in three phases of collaborative learning (orientation, intermediate, and reflection phase) as well as the near transfer of socio-cognitive and socio-emotional monitoring activities in the subsequent task work.

The preliminary analysis showed how the groups used the provided script in their group work and how the script stimulated monitoring activities. In general, the students used the external support more thoroughly at the beginning of their group activities for orienting themselves to the group and to the task than for coordinating their progress or evaluating and reflecting on their performance. These results are promising in terms of stimulated orientation discussion, since prior research has shown that well conducted orientation contributes to students' proactive engagement in the task (Eby and Dobbins 1997; Salas et al. 2005). Orientation provides foundational metacognitive knowledge on which groups can set goals and make plans for approaching the task as well as to create standards against which to monitor and coordinate their progress and products (Miller and Hadwin 2015). However, as this study also indicated, not all the groups in all situations achieved a high-level orientation discussion, which is worrisome since a lack of group orientation can debilitate team performance (Hillyard et al. 2010). Furthermore, even with the prompted support of the macro script, the groups were generally less engaged in the intermediate or reflecting phases than in the orientation phase. This observation connects to other studies that have shown that monitoring and reflection can be challenging for student groups (Järvelä et al. 2016b). Reflection, in particular, was very weak, despite its importance for learning and for learning transfer to new situations (Zimmermann 1989). To be constructively reflective, learners should be reflective about their own performance, their learning experience, and their methods or strategies of learning (Schunk and Zimmerman 1998).

In the preliminary analyses, we further observed differences in the types of monitoring the script phases activated. The orientation phase activated significantly more monitoring of task understanding and of socio-emotional experiences than did the two latter script phases. The intermediate phase stimulated the groups to monitor the task progress compared to the other two phases. These findings are somewhat expected, as they reflect the questions given in the script. Interestingly, providing socio-emotional support was the only type of group activity that was actively present in all of the script phases, even though the script prompted only the awareness of emotions, not providing support. It may be possible that the script discussion was beneficial for group members to open up their feelings toward the task and group work, and thus it increased their group-level awareness and made

the positive socio-emotional expressions more salient (Baker et al. 2013). In practice, the time spent in the scripted discussions supported the groups in more clearly communicating their personal emotional experiences such as lack of interest, exhaustion, frustration and cognitive challenges in understanding the task. This, further, activated them to encourage each other or boost their team spirit.

Even though the preliminary analyses indicate that the regulation macro script supported collaborative learning by introducing the reason for interaction, the script did not guarantee high-level regulation interaction. We could clearly differentiate between more active and less active script discussions where both the length and the quality of scripted interaction differed. Our results showed that the more active and the less active script discussions differed in terms of the frequency of monitoring activities that the interaction involved, especially in terms of providing socio-emotional support. The differences between monitoring activities was explored in depth with qualitative examples from the two case groups' orientation, intermediate and reflection script discussions. The Case 1 Group members were showing interdependency and explicitly building a safe socio-emotional atmosphere for collaborative learning by highlighting the value of sharing ideas, stating opinions, giving explicitly a space for everyone to contribute, and having a general mind-set to learn from each other's ideas and points of view. Thus, a variety of both socio-emotional and socio-cognitive monitoring activities were observed during the scripted discussions. The Case 2 Group also explicated a positive socio-emotional atmosphere, but their script discussions were short and lacked details. In other words, neither productive socio-emotional nor socio-cognitive monitoring was especially activated in this group.

The observed differences reflect the study by Hämäläinen and Häkkinen (2010), who examined the difference between ideal script use and actual script use. Their study indicated that different groups act differently despite using a similar script. Our results also connect to the findings by Rogat and Linnenbrink-Garcia (2011), who observed differences in social regulation in elementary school students working in groups on a series of three mathematics tasks. Their findings indicated that while some groups demonstrated in-depth interpretation of the task while planning, others simply read the instructions and started the task with little discussion of what the task meant. The authors further suggested that this type of low-quality working disrupted group progress by undermining engagement and interfering with monitoring (Rogat and Linnenbrink-Garcia 2011).

Our observation of the frequency of both socio-cognitive and socio-emotional monitoring in the more active script discussion links to the prior research that has highlighted the connection between groups' positive socio-emotional interactions and high-level cognitive functioning (Barron 2003; Mullins et al. 2013; Van den Bossche et al. 2006). For example, Lajoie et al. (2015) found that positive socio-emotional interaction created space for cognitive interaction towards problem solving. Also, Polo, Lund, Plantin and Niccolai (2016) argue that research needs to

see emotions as part of the ongoing cognitive efforts and make participants aware of how social roles are affected by emotion and how participants need scaffolds to help regulate the collaborative efforts.

The second research question moved the focus to the task work phase between the scripted phases and evaluated how the groups' socio-cognitive and socio-emotional monitoring were transferred to the task activities after more active and less active script phases. The results showed that the group work after the active script discussion included more attempts to provide socio-emotional support within the group than did the group work after the less active script discussion. Prior research has shown that positive social interactions are often formed at the early stages of the collaboration but that it also needs to be maintained throughout the collaboration (Rogat, and Linnenbrink-Garcia 2011). The scripted phases in this study gave groups time and space to consider their emotional experiences and to trigger their strategic evaluations to consider if they needed to make some changes to their group work. Furthermore, once socio-emotional support was stimulated during the script discussions, it tended to continue during the task working. The in-depth analysis of the task work showed differences between groups in terms of how often and in which ways they offered socio-emotional support within their group. The Case 1 Group members challenged their own and each other's thinking more often than did the Case 2 Group students, and that was also reflected in the types of socio-emotional support they provided. What was particularly visible in the Case 1 Group interaction was their tendency to give positive attention to each other's contributions and also their ability to be aware of their need for compromises. It can be summarised that the same themes that were present in their scripted discussions, namely valuing the group work, valuing each other's contributions and valuing the ability to make compromises, also occurred in their task work phases in terms of the socio-emotional support they provided. In contrast, the Case 2 Group's socio-emotional support was more directly targeting the current activities in the group, like complimenting the task work. The students were not explicating the values of their group work in their script discussion nor during the task work. One explanation for this can be that the discussions on the socio-emotional experiences increased awareness of the overall socio-emotional atmosphere in the group, and thus the students also paid more attention to it during their unscripted task working.

The question of how scripted activities are actually enacted in different learning situations, or how students and groups appropriate the script in their group working is current topic in the CSCL scripting research (i.e. Noroozi et al. 2017; Stegmann et al. 2016; Tchounikine 2016). Our study explored the issue by examining how scripted activities were actually enacted. Noroozi with colleagues (2017), in turn, emphasise second-order scaffolding in terms of exploring whether designed scaffolds can help students to acquire competences that can be transferred by the students themselves to various learning tasks. Our study is connected with transfer issues in evaluating how scripted interactions were thematically transferred to

discussions that were not directly scripted. This study contributes to the current CSCL script discussion by offering an empirical example of how groups make use of the external support (cognitive and emotional) offered to them in authentic teacher education course environment during an extended period of time (six weeks).

Our contribution extends this prior work by directly offering scripting elements to support socio-emotional aspects within collaborative interaction. Even though several authors (e.g. Tchounikine 2016) have highlighted the meaning of emotional and relational processes, to the best of our knowledge there is no previous work that has explicitly supported socio-emotional processes with scripts. However, Järvelä and colleagues (2016a) as well as Miller and Hadwin (2015) designed a technological support for collaborative learning that also acknowledges the emotional aspects of group work. In detail, their approach aimed to increase learners' awareness of their own and others' learning processes by prompting learners to evaluate their ongoing group activities (Järvelä et al. 2016a). Whereas their study used technology as an individual reflection instrument, our approach used technology to prompt the students' face-to-face discussions on a group level. In other words, scripting was used as a pedagogical method for framing effective learning activities to create opportunities for group members to become aware of their own and each other's thinking, understanding, and feelings so that together they could monitor and control their shared learning activities.

Limitations

This study, like other similar studies implementing an exploratory and observational approach, can be criticised due to its lack of generalisability of the results. As observational methods afford details and context specificity on how the certain phenomenon is activated under certain circumstances, the possibility to draw general conclusions of how, for example, the socio-cognitive and socio-emotional monitoring generally appears, is limited (Järvelä et al. 2013). A clear limitation of the study is a lack of control group, and thus, the real effects of the designed regulation macro script cannot be determined. As there is no control group, there is no way to rule out the possibilities of group related and situation specific factors that may have affected to groups to be sometimes more engaged in script discussions and to transfer the regulation activities also to unscripted task phases. However, this study actually is about how different groups enact the same script in different ways in authentic learning situations. Some groups seem to welcome certain kinds of prompts (like Case 1 Group did regarding the socio-emotional monitoring prompts) and to even transfer the prompts to phases in which the script is not presented, while others do not (Case 2 Group).

Several methodological decisions that were made during the data analysis need to be discussed. In this study, the unit of the analysis was focused on the group

level, as we did not account for group members' individual regulation activities. This decision naturally limits our power to elaborate on whether there were differences between situations because some members were more active than the others. However, the same decision was also made in Sinha et al.'s study (2015), and they also pointed out that studying a group level phenomenon also means that it is inextricable from the individual, highlighting how interactions within the group context influence its quality (Rogat and Adams-Wiggins 2015; Rogat and Linnenbrink-Garcia 2011, 2013). The second methodological solution of this study was to use the time interval as the unit of the analysis. Sinha et al. (2015) used a similar approach. However, whereas Sinha with colleagues (2015) implemented a five-minute interval, our approach was used in 30-second intervals. These types of occurrence ratings afforded capturing how the monitoring strategies were used for that time period and allowed us to observe each group situation in a structured manner and to detect overall variations in monitoring patterns within and between groups. Furthermore, this level of detail did not lose information regarding the moment-to-moment nature and fluctuations in collaborative interaction.

Future research directions

As research of regulation of collaborative learning is emergent, a key direction for future research is how and when regulation processes are activated in groups, how individual and social aspects of regulation intertwine, and how regulation can be supported. This study gives interesting research questions and reasoned hypothesis based on our observations to be explored in the future studies. For example, situational differences between groups and tasks found in this study requires more detailed further analysis. Further studies are needed to explore why some groups are more engaged in script use and use it for orienting, coordinating and evaluating their group learning, whereas others use the script less effectively. Future studies could aim for answering the following research questions: What makes groups adopt or ignore certain script prompts? What are prerequisites that determine compliance to the script prompts? Which group characteristics are problematic in that respect?

Furthermore, much remains to be understood regarding the types and configurations of support that best promote regulation of collaboration. Are there other ways in which groups who do not comply with the script can be supported during their learning? Do they need more or other kinds of script prompts? For instance, it is unclear how much support learners require at the individual or group level, in what kinds of tasks or learning situations, and whether too much support may impinge on interaction and groups' processes (Dillenbourg 2002). It also remains to be investigated to what extent the effects of scripts translate into the long-term impacts of such scripts on individual outcomes. Therefore we suggest that follow up research could be aimed at this question. This could have

consequences not only for the design principles of such scripts, but also for the transfer of learning from group to individuals in the long-term.

It would be insightful to evaluate with a quasi-experimental setting if the regulation macro script would have for example a near- and/or far-transfer effect. This would give more comparable information to see to what extent students can transfer their acquired regulation skills for application in similar collaborative learning situations. However, having said how transfer could be tested, one needs to keep in mind that group situations are always unique constitutions of its members' prior experiences and situational characteristics. As members collaborate, they encode, interpret, and recall information together, and in so doing they create knowledge that becomes embedded in a group's structures and processes. Therefore, research should also value groups as collective ecosystems that create their own working cultures and norms, and no situation is entirely replicable to another. This makes also group interaction analysis unique, by its methodological approach and by the information that can be gained by the groups without too much controlling their interactions.

Conclusion

This study developed a detailed regulation macro script to support collaborative learning and analysed socio-cognitive and socio-emotional monitoring in more and less active scripted discussions in three scripted phases, and how the monitoring activities were transferred to the task work that followed active and less active script discussions. We agree with Tchounikine (2016) that in a learning situation the script itself is not important; rather it is what learners' construct in relation to the script – that is, how learners have perceived, understood, and made the script their own. Furthermore, we also agree with Stegman et al. (2016) that group-level negotiations of the script are crucial for how a group of learners interacts and makes use of the script. Our claim is that social regulation of learning is not an outcome but rather a process of socio-cognitive and socio-emotional monitoring that sets the stage for better collaboration (Hadwin et al. 2016). Successful collaborative learning includes learners' meta-level knowledge about cognition, motivation, and emotion, which are manifested through the monitoring, negotiating, and aligning of understandings (Järvelä et al. 2016a). This process can be supported through scripting, but more evidence is needed about the contribution of such approaches and tools to the quality of collaborative learning. Collaborative learning can be challenging for groups, and often social regulation activities are lacking or they are weakly conducted. Thus, the knowledge of and the ability to implement monitoring practices can provide direction for students to move towards more productive collaboration. The findings of the study can be used to design and provide support for small group collaboration. Based on the findings of this study, it can be concluded that future studies are needed for evaluating the different

phases of group interaction, and particularly to design pedagogical support for groups to also engage actively in the intermediate and reflection phases during collaborative learning.

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