Combining Scripts, Group Awareness Tools and Self-Regulated Learning – Theoretical Implications and Practical Implementations

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Abstract: Collaborative learning can be challenging. Not only do learners need to have collaboration skills and knowledge about beneficial interaction processes, but they also need to monitor socio-cognitive conditions to be able to regulate their own as well as their learning partners' behaviour. External collaboration scripts are an explicit way to support collaborating learners and compensate for insufficient cognitive schemata, so called internal collaboration scripts. Group awareness tools guide learning activities implicitly and compensate for a lack of awareness of relevant socio-cognitive conditions while explicitly relying on the learners' self-regulatory skills. A combination of the different approaches has been investigated scarcely so far, though they have a promising potential for mutual synergies. Thus, in this symposium, researchers from scripting-, group awareness-, and regulation-research discuss how their approaches are connected and how external collaboration scripts or group awareness tools can be combined to support collaborative learning.

This symposium brings together researchers from different areas of collaborative learning: from script theory, group awareness research and self-regulated learning (SRL). The three areas are well established within the field of collaborative learning research but so far, they have only rarely been connected and related to each other. The approach of the symposium is twofold. First, we will show the conceptual connections between theories about internal collaboration scripts (Fischer, Kollar, Stegmann, & Wecker, 2013), metacognitive learning regulation (Winne & Hadwin, 1998) and group awareness (Bodemer & Dehler, 2011). Second, we will integrate scaffolding mechanisms that have been researched mostly separately and based on their equivalent theories: socio-cognitive scaffolding by external collaboration scripts (Kollar, Wecker, & Fischer, 2018) and cognitive group awareness tools (Bodemer, Janssen, & Schnaubert, 2018).

First, Schnaubert and Vogel introduce learning regulation and group awareness as integral parts of internal collaboration scripts. Then, Bodemer, Fischer and colleagues, and Tsovaltzi and Puhl, introduce cognitive awareness tools and external collaboration scripts as means to support collaborative learning. They have distinct perspectives from cognitive group awareness and respectively collaboration script research and highlight how both means of collaboration support can be integrated and mutually enhance each other's effectiveness. Finally, we look back at our view on learning regulation, group awareness and collaboration scripts, which will be further discussed at ICLS by Roger Azevedo.

Internal collaboration scripts, group awareness, and learning regulation: Towards a theoretical integration

Lenka Schnaubert and Freydis Vogel

Internal collaboration scripts are cognitive schemata that determine learners' behaviour and social interactions during collaborative learning situations. The script theory of guidance explains how script components are sequenced and hierarchically composed (Fischer et al., 2013). Script components are represented by (1) scriptlets comprising information about the activities of individuals within a collaborative learning situation, (2) scenes comprising information about the sets of scriptlets for different individuals, (3) plays comprising information about the sequence of scenes, and (4) roles comprising information about which scriptlets are connected to individuals. Depending on the interpretation of a social situation and perceived goals, learners activate a specific collaboration script that prescribes the play, scenes, scriptlets and roles, guiding the learners' behaviour in that

scenario. The scripts can be flexibly adapted by, for instance, integrating new components or changing the sequences of components to serve best the specific conditions emerging in different social situations.

To be functional for collaborative learning, the components of collaboration scripts integrate activities that are supportive for the individual acquisition of knowledge and skills through collaboration. For instance, mutually building on each other's contributions (e.g., Chi & Wylie, 2014) or problem solving activities, such as negotiation, sharing ideas and maintaining communication (Liu, Hao, Davier, Kyllonen, & Zapata-Rivera, 2016), play a major role when identifying learning-beneficial script components. Also activities to regulate each other's learning may be part of collaboration scripts. For collaborative learning scenarios, Järvelä and Hadwin (2013) propose three ways in which learners can regulate their learning to enhance their outcomes, namely self-, co- and shared regulation. However, learners often lack a functional internal script for specific collaborative learning situations. To support learners improving their internal script currently available, external scripts are applied as socio-cognitive scaffolding. These external collaboration scripts mostly consist of a sequence of prompts that reflect the script components on the play, scene, and scriptlet level the learners should ideally activate at specific points during the collaborative learning process. Learners who are guided through such an ideal collaborative learning process are enabled to gradually adapt the components of their activated internal script.

The adaptation of the collaboration script needs a process of monitoring and evaluation of the success of the activities learners are engaged in by using the currently activated script. From a self-regulation perspective, learners within a given learning situation need to monitor internal and external conditions to match appropriate learning activities or strategies (e.g., Winne & Nesbit, 2009). These strategies produce outputs that may be evaluated against internal standards, not only feeding back into the current collaborative learning process itself, but also informing the learner about the success of the learning strategies (Winne & Hadwin, 1998). Such metacognitive knowledge about own learning processes may thus be used to reconfigure existing collaboration scripts and develop new script components for specific situations (Tsovaltzi, Bodemer, et al., 2017).

So, how can learners have their regulatory processes stored within an internal collaboration script, but simultaneously regulate the implementation of the same script? Metacognition theory may provide a solution to this problem. Nelson and Narens (1990) proposed two cognitive levels differentiated by the content of the cognitions in question: an object level containing cognitive schemata and processes related to the content matter and a meta level containing a dynamic model of the object level used to evaluate one's own state of learning and to regulate (object-level) learning processes. Both levels may inform each other. In line with this differentiation, we propose regulation being related to collaboration scripts in two ways. Firstly, regulation processes are included in the sequence of activities specified by a collaboration script. For instance, a collaboration script targeted at discussion for knowledge building may contain regulation activities such as monitoring the conflicting positions within a group and adapting collaboration processes accordingly. These regulatory processes may include self-, co-, and shared regulation like negotiating a shared understanding of the content before deciding on how to proceed. Secondly, regulatory activities on a meta level may target the collaboration script itself. In this case, the script on the object level has to be monitored and regulated by meta-level regulatory processes. This means that the regulation processes are not part of the collaboration script but enable learners to adapt the script based on monitoring its effectiveness within a given learning situation. Thus, although collaboration scripts themselves include regulatory activities, these target cognitive and collaboration strategies within the script, whereas regulatory activities on a meta level target script implementation and adaptation.

In both ways, the regulation of learning heavily depends on learners' knowledge about specific characteristics of the learning situation. One central aspect within these collaborative learning situations are the socio-cognitive conditions within the group (e.g., Schnaubert, Heimbuch, Erkens, & Bodemer, 2019). Without information about the learners within a group (e.g., their knowledge and cognitions), collaborative processes are bound to fail as the lack of relevant socio-cognitive knowledge may impede the activation of proper components of the collaboration scripts. Socio-cognitive conditions are inherently important for interaction processes and highly dynamic and thus, group awareness research is concerned with how learners monitor relevant group characteristics, states and processes and how this affects collaboration (Bodemer & Dehler, 2011; Bodemer et al., 2018). However, little is known about how such information feeds into collaborative knowledge on the meta level necessary to activate, implement and adapt collaboration script components. The conceptual connection to internal collaboration script theory will help to specify how group awareness is anchored in human cognition and how learners succeed in using group awareness to regulate interaction processes in social situations.

The following three contributions will focus on the design of collaboration scripts and group awareness tools to overcome difficulties learners face when left on their own throughout collaborative learning. Group awareness research attributes these difficulties to a lack of experience with a specific situation or a lack of awareness about relevant socio-cognitive characteristics of the situation and supports group awareness externally via specifically designed group awareness tools (Bodemer, this symposium). From a script perspective, learners

often do not activate or even possess the internal script that would be most advantageous in a certain social learning situation, and thus external collaboration scripts are designed to support the activation of a learning-beneficial internal script (Fischer et al., Tsovaltzi & Puhl, this symposium). A further difficulty is that the collaborating learners all must activate scripts that mutually fit to each other. Thus, they need to negotiate a shared task perception and learning strategy (Järvelä & Hadwin, 2013). The combination of both group awareness tools and collaboration scripts is introduced as a promising way to overcome the difficulties from those various perspectives.

Cognitive group awareness tools – Opportunities and difficulties for SRL

Daniel Bodemer

Cognitive group awareness tools (CGA tools) provide knowledge-related information about a group or its members. Such information can be based on different sources (e.g. self or external assessments, tests, navigation behavior, created artifacts) and can be provided to learners in different ways (e.g., written vs. visualized, or complex and highly detailed vs. easy to understand and to compare). CGA tools intend to facilitate collaborative learning by making learners aware of the provided socio-cognitive (e.g., a learning partner's ideas) or socio-metacognitive (e.g., the learning partner's evaluation of her ideas) information (cf. Bodemer et al., 2018). Many beneficial learning activities in a social situation cannot be carried out without awareness of such information. For example, being aware of gaps in knowledge within the group may help to focus on and clear up uncertainties, thus regulating the learning process based on socio-cognitive information (e.g., Schnaubert & Bodemer, 2019).

In studies that disentangle specific functions and mechanisms, it has been shown that such information can help learners to build a proper model of the learning partner's expertise (e.g., Bodemer & Scholvien, 2014), to focus the learning partners' communication to particularly relevant parts of a learning material (e.g., Scholvien & Bodemer, 2013), or to use it for individual and shared regulatory processes (e.g., Schnaubert & Bodemer, 2019).

In the Learning Sciences, however, CGA tools are particularly well known for another feature that is often interconnected with the aforementioned functions: tacitly providing guidance or scaffolding for learning-relevant collaboration and communication behaviors. With this focus, CGA tools can be contrasted with rather explicit guidance or scaffolding measures such as external collaboration scripts or prompts. The didactical goals underlying these measures are often the same: a specific learning, collaboration, and communication behavior is suggested, which is supposed to be beneficial to learning, such as asking a slightly more knowledgeable person, explaining topics that a peer learner has not yet understood, or discussing conflicting perspectives.

Naturally, implicit guidance measures offer more space for SRL decisions than explicit instructions. Learners may or may not use socio-cognitive information for the processes intended by a teacher or an instructional designer. For example, in our experimental studies as well as in our teaching, we frequently observed that many learning groups provided with content-related hypotheses of the group members dealt mainly with topics to which different assumptions existed or of which only a part of the group members could formulate a hypothesis at all (e.g., Bodemer, 2011). However, there were always groups of learners that chose other procedures, such as avoiding discussions on conflicting perspectives. While this might be interpreted as a non-optimal learning behavior, it can also be adequate considering the learners' individual prerequisites and preferences. For example, we have identified interindividually differentiating attributes that influence the effective use of CGA tools, such as discussing diverging opinions when conflicts were generally perceived as challenging (e.g., Bodemer & Scholvien, 2014), or using CGA tools in a more helpful manner when learners had a high Need for Cognitive Closure (Heimbuch & Bodemer, 2018).

On a more fine-grained level, we observed that learners chose the potentially best learning opportunity, such as dealing with controversial perspectives (e.g., Heimbuch & Bodemer, 2017) or asking a more knowledgeable learning partner (e.g., Schlusche, Schnaubert, & Bodemer, 2019), but still could not make best use of the provided CGA information (e.g., learners dealt with diverging opinions but did not systematically identify and discuss the underlying evidences or assumptions). Those learners seemed to lack adequate internal scripts building on this information to regulate their own and their learning partners' behavior. Besides missing prerequisites, one reason for such observations is that most empirical studies on CGA tools did not provide explicit information about how the tools might or should be used to foster individual and collaborative learning processes.

A third observed difficulty in the self-regulated use of CGA tools is that only very few learners adopt the support given by the tool in the sense of an internalized script and transfer it to learning situations without CGA support (Bodemer & Scholvien, 2014). While such transfer might be desirable, the finding is not too surprising as –besides the other aforementioned reasons– learners can use CGA tools on the fly without elaborating their functionalities and thus probably do not see the need for CGA-related internalisation processes on a meta level. Thus, there is a lot of potential in augmenting CGA tools by more explicit measures: providing external scripts or prompts that prescribe or recommend specific behavior, giving instructions or assignments that explain how CGA

tools work and how they might be used properly, supporting elaborating and mentally constructing internal scripts by training a beneficial use of CGA tools, or fading out tool related external scripts. Such measures may support learners who are not intrinsically driven to make use of visualized conflicting knowledge constellations, provide missing regulative guidance to use the given information during collaborative learning, or even support a longer-term benefit of CGA tools in the sense of a transfer effect to situations in which no CGA tool support is given.

Diagnosing together – How can collaboration scripts and cognitive group awareness tools scaffold interdisciplinary reasoning in medical education

Frank Fischer, Anika Radkowitsch, Ralf Schmidmaier, and Martin Fischer

In this contribution we present how collaboration scripts can support diagnosing together in interdisciplinary contexts and how cognitive group awareness tools could possibly enhance the effects of such scripts. In many professions, people need to solve problems together. Increasing specialization requires more and more interdisciplinary reasoning. Recently, new models on collaborative problem solving have contributed to a better understanding of the different processes necessary for successful collaborative problem solving and factors influencing these processes (e.g., Liu et al., 2016). In this contribution, we use the CDR model of collaborative diagnostic reasoning (Radkowitsch, Sailer, Fischer, Schmidmaier, & Fischer, in press), apply the model to a prototypical interdisciplinary medical setting and derive suggestions on how scaffolding can be introduced in this context to help learners becoming more proficient in diagnosing together.

The CDR model builds on Klahr and Dunbar's (1988) SDDS model of scientific reasoning and adapts it to the context of collaborative diagnosing (Radkowitsch et al., in press). The CDR model is a process model of collaborative diagnostic reasoning of two reasoners who engage in collaborative diagnostic activities such as eliciting, sharing, and negotiating hypotheses and evidence. The CDR model further extends the SDDS model by introducing individual components of a competence for successfully engaging in collaborative diagnostic activities. These include cognitive and social components. Both groups of components draw on two distinct bodies of knowledge, general and professional. General social skills include internal collaboration scripts that are not specific to the professional context of an individual. These skills have been learned from very early childhood onwards (Miller, 2009). With education in a profession, more specific professional collaboration knowledge is developing, building on and possibly interacting with the existing generic social skills. Professional knowledge on collaboration includes internal scripts on the interaction with medical professionals with the same specialization but also different specializations, coming from other sub-disciplines. For medical professionals with different specializations, meta-knowledge is crucial. Meta-knowledge is knowledge about a sub-discipline or specialization and on the consequences for effective interaction with professionals coming from this specialization. Meta-knowledge can enable evaluating the partner's level of proficiency and the related regulation of the diagnostic activities to optimize the likelihood of an optimal diagnosis (e.g., Meier, Spada, & Rummel, 2007). The CDR model also includes developmental assumptions. For example, the CDR model suggests a decreasing influence of general cognitive skills on diagnostic activities with increasing professional knowledge.

An application of CDR to an interdisciplinary medical context may be illustrative. In a research project on collaborative diagnostic reasoning, we analysed the interaction of internists and radiologists in a prototypical context that is, an internist encountering a patient suffering from fever. The internist is likely to consult a radiologist with a request to apply one or more specific radiologic examinations to identify the causes of the fever. In an expert interview study, we found, that the internists frequently do not adapt their sharing of hypotheses and evidence to the needs of the radiologic partners, often remain left with unjustified or too unspecific requests. According to the CDR model, this may have different reasons. A main reason is likely to be the lack of professional collaboration knowledge, or the lack of its application. Among the different aspects of professional collaboration knowledge, the meta-knowledge about radiology seems to be crucial. Meta-knowledge in this interdisciplinary constellation is supposedly including specific examinations and their necessary justifications, and the internal collaboration scripts to request them appropriately (Radkowitsch et al., in press).

How can we conceptualize the support for collaborative diagnostic reasoning in such a scenario? Explicit guidance through external collaboration scripts can prompt the use of already accessible professional collaboration knowledge. This knowledge can consist of complex internal scripts if learners already have experience with the situation, but would not yet be activated spontaneously while instead relying on generic social skills. Prompting can then take place on a play or scene level (Fischer et al., 2013). Prompting on higher script levels is also most promising when learners already dispose of the necessary internal script components but these are distributed over several knowledge networks and are not yet part of a coherent collaboration script for the specific situation - for example, if learners have experience with other forms of professional collaboration from which some aspects can

be readily transferred. In case learners are not familiar with the collaborative situation, scaffolding on a fine-grained level (scriptlet) would probably be more effective (Vogel, Wecker, Kollar, & Fischer, 2017).

Cognitive group awareness tools could offer implicit guidance through providing helpful information on the partner's specific background or level of experience (Bodemer et al., 2018). In our prototypical scenario, an awareness tool could provide missing meta-knowledge on the level of experience of the collaboration partner to help the internist adjust their collaborative diagnostic activities (e.g., a different sharing behaviour with respect to the collected evidence not to overwhelm an unexperienced radiologist). In learning environments with a simulated partner (e.g., Radkowitsch et al., in press), a cognitive awareness tool could support learners in the role of an internist in showing, for example, how satisfied a radiologist with a certain level of expertise was with the sharing and the justifications of the learner. The cognitive awareness tool could provide even further invisible information like the hypotheses and evidences a radiologist with a specific level of expertise currently considers in their mental evidence and hypotheses spaces without having it shared. Additionally, such tools could offer more generic meta-knowledge on radiologic examinations and the required justification.

How can explicit and implicit guidance be orchestrated in order to support medical students in diagnosing together? External scripts that guide sharing, negotiating and coordination processes are probably more effective for learners with less differentiated professional internal scripts; group awareness information might be more effective for learners with more developed professional internal collaboration scripts. Thus, a fading out procedure may entail external script components on a detailed level at first (scriptlet level) that is reduced to a less detailed level (scene level). Simultaneously, cognitive awareness information on the cognitive needs or the cognitive states of the partner can be displayed, and then gradually removed. However, it is also possible to think of fading more in the sense of increasing the level of assistance in order to assess the level of CDR skills of individuals. Starting with some rather light cognitive awareness information, then add external script scaffolds on a play level, scene and then scriptlet level. The less support learners need for effectively engaging in collaborative diagnostic activities, the more advanced their CDR skills are.

External scripts and group awareness tools – Where do they meet?

Dimitra Tsovaltzi and Thomas Puhl

This paper builds on the accounts on scripts and group awareness tools (GA tools) in the preceding papers. Despite external models provided by scripts to guide learners' behaviour in groups, internal scripts, represented in learners' cognitive systems, need to be appropriated by learners for cognitive and epistemic change to occur long term (Fischer et al., this symposium; Fischer et al., 2013; Kollar, Fischer, & Slotta, 2007). GA tools implicitly trigger social regulation processes to impact group learning processes, like conflict awareness and its regulation (Bodemer; Schnaubert & Vogel, this symposium; Phielix, Prins, & Kirschner, 2010).

There seems to be potential in combining these two instructional methods to promote an interaction of social regulation and cognitive regulation. However, this has rarely been investigated. To address the differential effects of explicit (scripts) and implicit (GA tools) guidance, we proposed a model that takes into consideration the modes of regulation they represent (Tsovaltzi, Bodemer, et al., 2017). The model introduces conflict awareness as a possible mediator between guidance and regulation processes, to explain learner behaviour and long-term learning outcomes. GA tools can be used to increase awareness about specific situational characteristics that can lead to learning opportunities when this information is relevant for the learners. GA tools, thus, help learners activate their internal scripts by externalising information that helps them reassess the situation and trigger self- and co-regulation processes. For example, if GA tools depict different attitudes in the groups and manage to raise conflict awareness, learners may be triggered to self-regulate their conflict, reassess their attitudes, and reassess their arguments, without explicit guidance. However, learners may not always have appropriate internal scripts. External scripts can help capitalize on learning opportunities by explicitly guiding learners to an appropriate behaviour. In the presence of conflict awareness, the external regulation that scripts impose is interpreted, understood as meaningful, and the script is appropriated and internalized. In our setting, a script to support arguments with evidence makes sense, in view of conflict that causes learners to reassess attitudes, and this behaviour may be adopted. Hence, mediated by conflict awareness, scripts may lead to procedural knowledge (the internalized script) and long-term learning. Without conflict awareness GA tools and scripts are unlikely to lead to a successful adaptation in behaviour, and hence, long-term learning is unlikely.

In a 2×2 semester long field-study (Puhl, Tsovaltzi, & Weinberger, 2015), we tested the combination of GA tools and argumentation scripts in a communication seminar. 105 German teacher trainees filled out a case-based questionnaire weekly, to capture their communication attitude in social interactions in the school. Each seminar was accompanied by one Facebook group, where students discussed problem cases based on the theories they learned. Students in the GA tool conditions saw a graphical visualization of the result of the communication

questionnaire presented in a Facebook App. It depicted their communication attitude in relation to others to increase conflict awareness. This information is implicit in online discussions, but awareness of this complex social situation may not be possible without the help of the GA tool, and socio-cognitive conflict may not arise. To support productive group regulation processes and leverage socio-cognitive conflict, we provided learners with an argumentation script. This consisted of modelling quality argumentative processes. Students in the argumentation script conditions received a weekly argumentation script in the form of feedback to arguments posted in the Facebook group. They had to pick and "like" the best argument. The feedback evaluated the epistemic quality (elaborating arguments using theoretical concepts and relations) and the formal quality (supporting arguments with evidence) for two selected arguments. Participants in the control condition just discussed in their Facebook group. Learners were expected to become aware of conflict between their own and the group's attitudes, experience dissonance. They should then and apply the script to argue qualitatively, resolve the conflict and release the dissonance (Eagly & Chaiken, 1993; Erber, Hodges, & Wilson, 1995).

We measured epistemic and formal argumentation processes by coding and counting, attitude change with a questionnaire, and domain knowledge in an exam containing definitions, facts, and higher order discursive processes like theory-based interpretations. We found an effect of scripts and of GA tools on processes of epistemic quality over time, formal quality was only significant for scripts. Domain knowledge was significant for both scripts and GA tools, but higher for scripts, and there was also a significant interaction between GA tool and argumentation script. The effect of GA tool and script on the quality of argumentation seems to take place after 4-5 weeks. There was an effect on communication attitude change over time, but not differences between groups. Social network analysis provided evidence that effects of GA tools and scripts on attitude change can be traced back in dynamic social processes that they promote (Tsovaltzi, Dutta, Puhl, & Weinberger, 2017).

In accordance with our model, learners with implicit guidance to socially regulate (GA tool) and explicit guidance to cognitively regulate (script) showed better group regulation processes and gained more domain knowledge long term. This provides evidence for the activation and appropriation of internal scripts respectively. The role of conflict awareness was also supported, because increasing conflict awareness (GA tools) and additional cognitive support (scripts) led to higher domain knowledge in combination, compared to scripts alone. We also had evidence for increased regulation processes which points to script activation and appropriation through conflict awareness. Attitude change presupposes conflict awareness and cognitive dissonance and was promoted by GA tools and scripts in combination through increased dynamic social processes. Understanding the socio-emotional mechanisms that leverage conflict awareness would allow a better calibration of regulation supports for learning. It might also be useful to have direct measures of conflict awareness.

Supporting collaborative learning – A self-regulation perspective

Lenka Schnaubert, Freydis Vogel, Daniel Bodemer, Frank Fischer, Anika Radkowitsch, Ralf Schmidmaier, Martin Fischer, Dimitra Tsovaltzi, Thomas Puhl, and Roger Azevedo

This symposium integrates learning theories from the areas of learning regulation, internal collaboration scripts and group awareness. It also provides an overview of current trends to combine explicit and implicit guidance and scaffolding approaches, such as collaboration scripts and group awareness tools, to support collaborative learning processes. From both, the perspectives of collaboration scripts and group awareness tools, the respective other means of support is seen as beneficial if not necessary to offer valuable support for collaborative learning. In their theoretical approach, Schnaubert and Vogel rendered how group awareness is particularly important for the regulative processes that are demanded by collaboration scripts and are needed to successfully adapt internal scripts. Bodemer emphasized the importance of external support that can be offered by collaboration scripts, to help learners make use of the information the more implicit group awareness tools provide. Fischer and colleagues stressed the need for group awareness tools, particularly for learners with varying expertise supported by collaboration scripts. Here, group awareness tools can offer information to the learners that is relevant to fulfil what the explicit external script support demands from them. Tsovaltzi and Puhl reported about first successful attempts to apply both collaboration scripts and group awareness tools to support learners' discussion of contradictory topics. Future research topics for the combination of collaboration scripts and group awareness tools were discussed, including the questions how both measures could best be integrated for different learning targets, for instance how fading of the measures might be needed to achieve sustainable and transferrable learning.

The contributions approach the combination and integration of group awareness tools and collaboration scripts from various theoretical and practical perspectives and they draw connections to (self-)regulatory processes. Basically, self-regulation and partner regulation of learning processes is seen as integral part of collaborative learning. On one hand, the regulation is thus part of the internal scripts, on the other hand, it helps to adapt these scripts to be more beneficial for learning. Furthermore, the regulation of learning processes can be

facilitated by both means of external support, collaboration scripts and group awareness tools. While collaboration scripts rather directly prompt to activate specific regulation processes, group awareness tools provide information about the state of the learning process in the group necessary to evaluate which type of regulation should be applied. The contributions in this symposium focus on collaborative learning mostly from the perspective of how cognitive change can be facilitated by external collaboration support. Self-regulation, however, is an essential motor not only for individual, but also for collaborative learning processes as it defines how learners steer their learning processes based on monitoring internal and external conditions, including the social context. Within individual-focussed research, such self-regulatory processes are frequently supported by providing learners with external guidance mechanisms like prompts or scaffolds to adjust their learning strategies (e.g., Azevedo, Cromley, Moos, Greene, & Winters, 2011), but also the provision of metacognitive awareness information has been used to implicitly guide self-regulatory attempts (Schnaubert & Bodemer, 2017). Collaborative learning scenarios entail an additional challenge as learners not only need to monitor and regulate their own, but also their peers' learning processes while simultaneously adapting their behaviour to the highly dynamic situation. However, the notion of metacognitively monitoring one's own or a partner's cognitive processes to adapt learning activities seems to be in the centre of both individual and collaborative learning. The adaptation of these processes is guided by metacognitive knowledge and internal scripts. These can be facilitated by externally scripting or scaffolding individuals as well as collaborating groups.

Based on the close connections to individual self-regulation theories and research, a discussion of regulatory processes, scripts, group awareness and scaffolds in CSCL cannot be completed without a critical view from a self-regulation perspective. Thus, we are looking forward to a discussion from Roger Azevedo.

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