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Do Different Goals Affect the Configuration of University Students' Internal Collaboration Scripts? Results of an Epistemic Network Analysis Study

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Abstract: Computer-supported collaborative learning (CSCL) offers a great potential for student learning. However, its successfulness is influenced by learners' internal collaboration scripts. Drawing from Script Theory of Guidance (SToG), which posits that internal collaboration scripts are dynamically configured based on learners' goals, this study explores how an induction of learning and performance goals influences the selection and sequence of activities learners perform during collaboration. *N*=233 pre-service teachers were asked to collaboratively analyze a classroom situation. The instructions included information on the importance of this task either for students' competence development (learning goal condition), or for their performance (performance goal condition). While we found no significant differences regarding the change of selected scriptlets, Epistemic Network Analysis revealed distinct configurations in the sequence of scriptlets for learning and performance goal conditions. The results partly support SToG's configuration principle, emphasizing the role of situational goals in shaping internal collaboration scripts.

Aims

Computer-supported collaborative learning (CSCL) serves as a powerful instructional method to support student engagement in high-level socio-cognitive processes (e.g., Chen et al., 2018). The way learners act in CSCL environments can be considered as being influenced by two forces that mutually interact with each other: (a) the design of the learning environment, and (b) the learners' learning prerequisites. With respect to (a), CSCL research has accumulated numerous insights, for example on the effects of different kinds of scaffolds on collaborative learning processes and outcomes. With respect to (b), there is considerably less empirical research. One prerequisite that has particularly been suggested in the context of research on CSCL scripts (i.e., scaffolds that structure the collaboration process through the provision, specification and distribution of learning activities and roles within small groups) is the learners' internal collaboration scripts. According to the Script Theory of Guidance (SToG; Fischer et al., 2013), internal collaboration scripts are cognitive structures of individuals that guide them in the way they understand and act in collaborative learning situations. According to the SToG, internal collaboration scripts consist of different knowledge components (play, scenes, roles, and scriptlets) that are dynamically configured in learners' memory. One central principle of the SToG refers to the assumption that this configuration is influenced by the current goals of the learners (internal script configuration principle).

Yet, it is striking that this principle has hardly been tested empirically so far. In fact, learners can have very different goals when collaborating and it is not clear exactly how these affect the configuration of their internal collaboration script (Pintrich, 2000a). A prolific model to conceptualize goals in the context of teaching and learning is Achievement Goal Theory (Dweck & Leggett, 1988; Elliot, 2005). However, so far there is only limited research on how goals are related to the configuration of the learners' internal collaboration scripts. For this reason, in this paper we investigate how different goals, respectively their induction, are related to learners' internal script configuration in the context of CSCL.

How internal collaboration scripts shape within-group collaboration – the Script Theory of Guidance

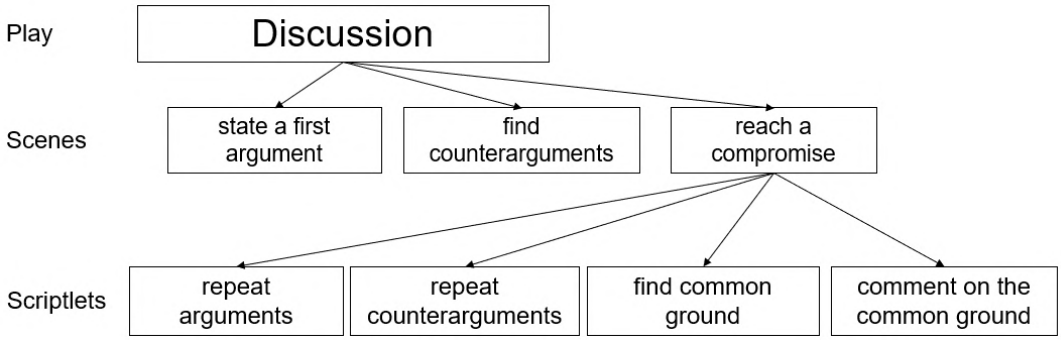
Based on recent meta-analyses, CSCL offers a vast potential to support learners' academic achievement (e.g., Chen et al., 2018). From a theoretical point of view, there are many potential benefits of collaborative learning, even without the support of digital technologies, which include academic (e.g., fostering critical thinking), social (e.g., developing social skills) or affective-motivational aspects (e.g., reduced anxiety; see Johnson & Johnson, 1989; Laal & Ghodsi, 2012). However, there may also occur problems during collaborative learning, such as individual learners not participating in collaboration or learners not actually working together but rather splitting the tasks among themselves (Roberts, 2005; Salomon, 1992). Especially in such circumstances, digital technologies may support the collaborative learning process, for example by providing tools to organize learners'

ideas and contributions, to provide resources or guidance to structure the collaboration process (Stahl et al., 2006; Suthers & Seel, 2012).

A theoretical approach that conceptualizes such guidance is the Script Theory of Guidance (SToG; Fischer et al., 2013), referring to such guidance as "external scripts". External collaboration scripts provide group learners with guidance on the kinds and sequence of activities and roles they are supposed to take over during collaboration, often supporting their execution via prompts or other kinds of scaffolds. SToG however assumes that what actually happens during collaboration is not only influenced by such external scripts, but also by the learners' internal collaboration scripts. According to the SToG, internal collaboration scripts are configurations of knowledge components in the learner's cognitive system that determines how they understand and act during collaboration. Based on Schank's (1999) dynamic memory approach, a basic tenet of the SToG is that internal scripts consist of configurations of four different script components (see Fig. 1): (a) The "play" component includes knowledge about the kind of the situation an individual experiences, e.g., a discussion held in a chat forum or the joint writing of a blog post. Once a learner has (consciously or unconsciously) selected a specific "play", this "play" then binds together a set of (b) "scenes". These include the person's knowledge about the different situations that typically make up the play. In a discussion, for example, a learner's "discussion" play might for example include a scene in which the group collects information to develop arguments, while another scene might be to exchange arguments. Once a certain scene is activated, the person also has expectations on what kinds of activities are typically part of that scene. Knowledge about these activities as well as the sequence of different activities that are likely to occur during that scene, according to the SToG, is represented in so-called (c) "scriptlets". In the scene "reaching a compromise", for example, the first scriptlet might be the summary of the most important arguments at the beginning. Finally, learners hold knowledge about different kinds of (d) "roles", i.e., about the question what kinds of activities are likely to be taken over by what person in a collaborative situation. Similar to a theatre play, roles can extend over several scenes and include several activities.

Figure 1

Example of an Internal Collaboration Script of a Learner During a Discussion



Note: Only a few examples of possible scriptlets are shown. Theoretically, every scene is connected to a specific set of scriptlets.

The Internal Script Configuration Principle within the Script Theory of Guidance

A central assumption of the SToG is that through experience, learners acquire a range of plays, scenes, scriptlets, and roles, and that these knowledge components are dynamically stitched together in each new situation. This idea lays the foundation of the so-called configuration principle of the theory. It states that "How an internal collaboration script is dynamically configured by a learner from the available components to guide the processing of a given situation, is influenced by the learner's set of goals and by perceived situational characteristics" (Fischer et al., 2013, p. 57–58).

As described, the internal collaboration script consists of different knowledge components of collaborative learning that are considered to be very flexible in the way they are combined with each other. This means that in any situation, a learner has different plays, scenes, scriptlets, and roles available in memory that they can apply to make sense of the current situation. Even small changes in the situation and changing requirements can result in a quick (and very often subconscious) adaptation and new configuration of the internal collaboration script components. For example, certain tool features such as a flashing cursor might indicate an opportunity to enter a text, making entries by learners more likely than if there was no such flashing cursor (Fischer et al., 2013; Kirschner et al., 2008; Schank, 1999).

Yet, not only situational characteristics (i.e., external factors) may influence a learner's script configuration, but also factors that lie within the person matter in this respect. This refers in particular to learners' goals. According to the configuration principle, a learner's goal can, on the one hand, influence the *selection* of script components, i.e., plays, scenes, scriptlets, and roles. This means that the learner is likely to choose or act out the script components that are most useful to pursue their current goal and may yield activities that are conducive to this goal and inhibit activities that are not. On the other hand, these very flexible configurations of knowledge components may also influence how these different activities are *sequenced* (e.g., prepare arguments, debate, compromise). Yet, also such sequences can be dynamically reconfigured (i.e., the order of the components can be changed) depending on perceived changes in the situation (including the learning partners' activities) or in the learner's goals. For example, if a learner notices that their learning partner does not seem to exert effort during collaboration, and if they have the goal to get the task done anyway, they may de-activate scriptlets that would guide them to ask their learning partner for input, and replace this scriptlet by a scriptlet "solve the task alone".

The authors provide evidence for the influence of goals on the configuration of learners' internal collaboration scripts by referring to a study by Pfister and Oehl (2009). Their study addressed the question of how goal focus, task type, and group size influence synchronous net-based collaborative learning discussions. For this, they varied the goal focus of the learners in so far as one group should follow an individual focus (i.e., they received rewards based on their individual performance), or a group focus (i.e., they received rewards based on their group's performance). Results indicated that learners with the group focus used more supportive features of the tool than learners in the individual focus. Fischer et al. (2013) interpret this finding in a way that the different focus of the learners has led to a (re-)configuration in their internal scripts, as represented in learners' use of different tool functions.

However, a couple of limitations of this study and of Fischer et al.'s (2013) interpretation need to be noted here. First, the (re-)configuration of the internal script is only inferred indirectly (from the use of a certain feature by the learners), rather than measured directly. To do that, it would be necessary to apply methods that lay the kinds of internal script components as well as their sequence open. Second, the authors of the study did not examine how the (initial) internal script of the learners was structured. Therefore, it is also not possible to assess to what extent this script and its components actually reconfigured. Third, "goal focus" was defined and varied by the authors as a distinction between individual-oriented and group-oriented performance. While this is certainly one way to think about goals, there is a vast amount of research on achievement goals that can be drawn on to differentiate different kinds of goals that have been shown to matter for learning. This research will be discussed in more detail in the next section.

Learners' goals during CSCL

From a theoretical perspective, goals describe a standard by which learners can assess their learning progress and initiate regulatory processes accordingly (Pintrich, 2000b). In particular, achievement goals refer to the goals that a learner pursues in learning and performance contexts. They describe their purpose for engaging in competence-related behavior (Elliot, 2005; Elliot & Fryer, 2008). At a global level, the theory distinguishes between two types of goals. Firstly, learners may have so-called *learning goals*, which means that they are particularly motivated to engage in learning because they focus on improving their competence. Secondly, they may also display *performance goals*; for learners with these goals, it is particularly important to engage in learning in order to demonstrate their performance or outperform others (Heyman & Dweck, 1992). In accordance with this, empirical research has often shown positive effects of learning goals on various learning processes and outcomes, whereas performance goals show more of a mixed picture. Some studies indicate positive, some negative effects on learning processes and outcomes and some do not reveal a clear pattern (Daumiller, 2023; Harackiewicz et al., 1998; Payne et al., 2007).

Although these findings already indicate that different achievement goals may lead to different learning processes and outcomes, research that looks at their direct impact on the configurations of learners' internal collaboration scripts seems to be lacking. Nevertheless, one might expect different achievement goals to have a particular impact on learners' scriptlets, i.e., on the knowledge they activate regarding the kinds and sequences of activities that are likely to occur resp. to be acted out during collaboration. In terms of the activities performed during CSCL, a pronounced learning goal might encourage learners in a collaboration to ask more questions or make more explanations, for example. In contrast, learners with pronounced performance goals, could be more likely to use impression management techniques and perhaps only want to appear competent, for example by using subject-specific language very deliberately (Greisel et al., 2023). Yet, empirical evidence on these issues seems to be missing so far.

Research question and hypotheses

In sum, various evidence from the field of CSCL, but also from research on achievement goals, indicates that different goals of learners may influence how learners act in collaborative learning. On this basis, the SToG also argues that learners' goals in CSCL lead to an activation of specific script components. However, so far there has been little research investigating this configuration and the actual change in the internal script as a function of the presence or absence of different achievement goals. Therefore, in the present study, we actively manipulated learners' goals either in the direction of an actualization of *learning goals* or of *performance goals* and investigated the effects of this manipulation on their internal collaboration scripts (more precisely, the scriptlets) when working on a CSCL task.

Our research question was: Do different kinds of achievement goals (learning goals vs. performance goals) influence the configuration of the internal collaboration script? We hypothesized (H1) that learners in the learning goal condition would *select* different scriptlets to guide their collaboration than learners in the performance goal condition. Furthermore, we assumed that not only the selection, but also the *sequence* of scriptlets would differ depending on the kind of achievement goal that is induced (H2).

Method

Participants and design

A total of $N = 233$ pre-service teachers participated in the study, who were on average 22 years old ($M_{Age} = 22.30$, $SD_{Age} = 2.30$), mostly female (72%) and in their fifth semester ($M_{Sem} = 4.99$, $SD_{Sem} = 1.14$). They were enrolled in a teacher education program for elementary school teachers, middle school teachers, high school teachers, and secondary school teachers of various subjects. The study was embedded as a compulsory part of a course in educational psychology for pre-service teachers. However, the students were free to decide whether they wanted to participate in the scientific data collection. They received no reward for their participation. Their task was to analyze an authentic, written case that described a problematic classroom situation and a teacher's efforts to solve those problems.

For collaboration, the students used the collaboration tool "coLearn!". This tool serves to structure collaborative learning with external collaboration scripts by assigning roles, specifying prompts and providing materials. To investigate how different achievement goals impact internal collaboration script configuration, we established a 1×2 between-subjects design with the conditions "induction of learning goal" and "induction of performance goal". The conditions differed in that their external scripts (that is, the instructions within the tool) included prompts that contained elements of the respective goal (e.g., for learning goal condition, that completing a respective task would be very important in order to expand one's skills, or, for performance goal condition, that their performance will be evaluated by their instructor). Participants were randomly assigned to dyads and to one of the two conditions mentioned before.

Procedure

During pretest, we measured students' initial internal collaboration scripts. The students then worked for three weeks using the collaboration tool "coLearn!". Then, they were grouped into pairs. First (Week 1), they were instructed to analyze a case vignette individually that described a teacher who faced different kinds of problems during her lesson, using one of two scientific educational theories (Cognitive Load Theory by Sweller, 2011, or ICAP framework by Chi & Wylie, 2014). Afterwards, these analyses were swapped between the students within a dyad, and the students were instructed to evaluate the analysis of their respective partner and to expand on it with the help of the respective other theory (Week 2). Afterwards, the students received this evaluation and elaboration from their peer and were asked to revise their original analysis on this basis (Week 3). After the collaboration phase, the students' internal collaboration scripts were measured again.

Operationalization of the independent variable

As described, the conditions differed from each other with respect to the presentation of statements in the external script that were integrated into the collaboration tool. Each week, a new page with instructions and entry fields was displayed in the tool. In addition to specific instructions regarding the case analysis, the prompts contained a specific goal induction. In the *learning goal* condition, after instruction, the task was labeled as "important in order to improve one's own competencies and to successfully cope with problems in later professional life". In addition, working with the tool was explicitly framed as a learning opportunity in this condition. In contrast, in the *performance goal condition*, it was stated that the task was "important in order to achieve good grades". In

addition, working with the tool was framed as an “important opportunity to prepare for exams”, and it was stated that tutors would check the assignments later.

Assessment of learners’ internal collaboration scripts

In order to assess the learners' internal collaboration scripts, prior to using the collaboration tool, in the pre-test participants described how they would generally carry out a collaborative analysis of a problematic classroom situation. They were given a total list of 40 activities (e.g., "asking questions", "reflecting on the theory" etc.) to choose from, representing different scriptlets that could be carried out as part of such a collaboration. The participants were instructed to drag and drop the activities they would perform from the list and put them in the order in which they would perform them. In this way, we captured their internal collaboration scripts regarding a collaborative case analysis considering the specific sequence of scriptlets. In the posttest, participants were instructed to select and arrange activities from the same set of activities using drag-and-drop and arrange them according to how they actually carried them out during collaboration.

To measure the extent of reconfiguration of participants’ internal collaboration scripts, we checked what activities (scriptlets) a participant added or omitted at post-test compared to the ones they selected at pre-test. Each activity was coded with a 1 if it was omitted or added from pre to posttest and with a 0 if it remained the same (i.e., both times selected or not selected). We summed these changes separately for three factors to ease interpretation of pre-to-post changes. We identified these factors with an exploratory factor analysis of tetrachoric correlations between the dummy-coded pre-test activities using weighted least squares and an oblimin rotation. The least frequent activities ($n < 10$ in pre- or post-test) were dropped before the analysis. The number of factors was determined using the post-test activities based on a scree plot, a map test and the VSS complexity 2 criterion. The resulting three factors were: task-related activities (e.g., “read case”), cognitive learning strategies (e.g., “imagine practical applications of new concepts”), and social learning strategies (e.g., “help peer”).

Statistical analyses

To test whether the reconfiguration of the internal collaboration scripts differed between the change of selected scriptlets (H1), we conducted separate ANOVAs for scriptlets referring to task-related activities, cognitive learning strategies, and social learning strategies. Regarding the sequence of scriptlets (H2), we conducted an Epistemic Network Analysis (ENA; Shaffer et al., 2016) with the activities reported in the post-test. We used a moving stanza window which was set to span across seven activities. Before the analysis, we dropped the four least frequent activities ($n < 10$ in pre- or post-test). Two further activities were dropped after the first analysis which were not connected to the rest of the network and represented outliers. To test H2, we report the subtraction network which compares the networks of learning and performance goal conditions and the corresponding *t*-Tests which compare the centroid values of both groups.

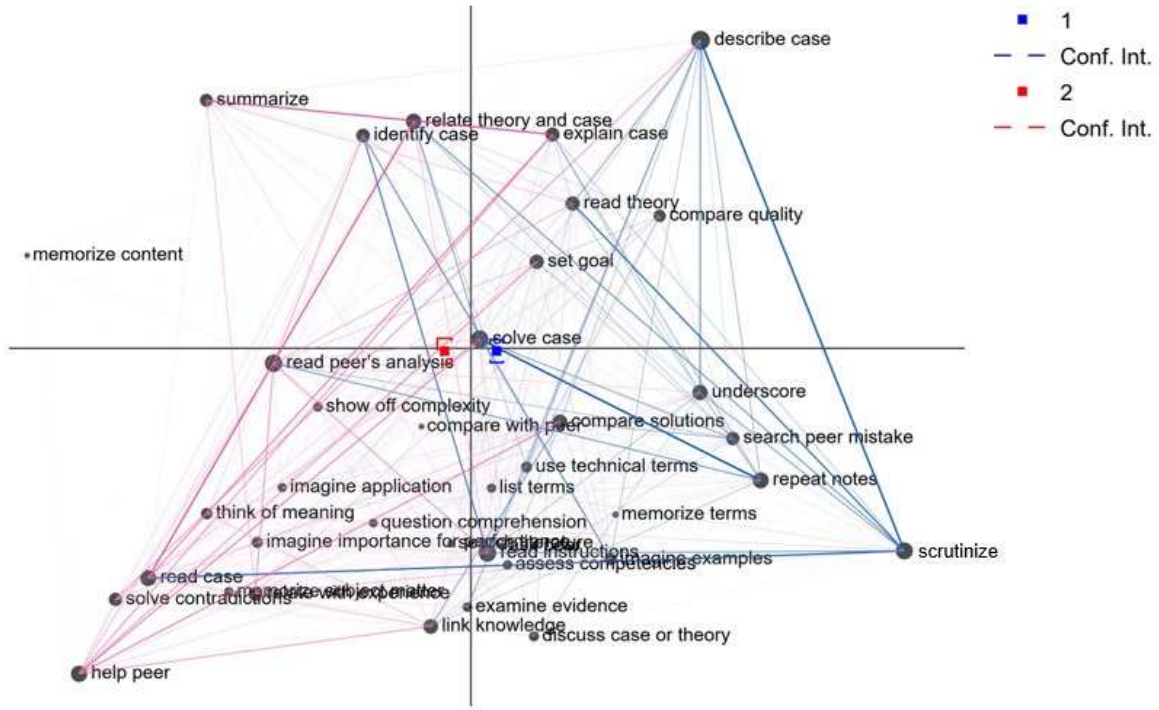
Results

To test H1 regarding the selection of the scriptlets in the pre- and post-test, we conducted three ANOVAs, one for each category of activities we had identified based on the factor analysis described above. There was no significant effect of condition with regard to cognitive learning strategies ($F(2, 231) = 2.04$, $p = .13$; $\eta^2 = 0.02$), task-related activities ($F(2, 231) = 0.73$, $p = .48$; $\eta^2 = .0063$), or social learning strategies, ($F(2, 231) = 0.64$, $p = .52$; $\eta^2 = .0056$). Thus, there were no significant effects of the type of achievement goal that was induced on the kinds of changes of activities (scriptlets) participants mentioned to have used during collaboration.

To answer RQ2, we conducted an ENA to compare the networks of scriptlets in each condition in the posttest (learning vs. performance goals induced). The mean centroid value for scriptlets in the epistemic network of the learning goal condition was significantly different from the mean centroid value in the network of the performance goal condition, $t(148.57) = 10.76$, $p < .001$, Cohen’s $d = 1.77$, indicating that the true difference in means is not equal to 0. Consequently, the results indicate that there were differences with respect to the sequence of the scriptlets selected between the conditions in which learning and performance goals were induced.

Subtracting the networks (Fig. 2) revealed that the network of the performance goal condition (red), in comparison to the learning goal condition (blue), displayed stronger connections between the scriptlets “read case”, “read peer’s analysis”, “relate theory and case”, “summarize” and “help peer”. In contrast, the learning goal condition showed a much stronger connection particularly between the “solve case” and “repeat notes” scriptlets. There were also comparatively stronger connections between the scriptlets “describe case”, “scrutinize” and “read case”.

Figure 2
Epistemic Network Analysis of the Difference Between the Networks of Scriptlets in Learning Goal Condition (1/blue) and Performance Goal Condition (2/red)



Discussion

The SToG (Fischer et al., 2013) assumes that learners' goals affect the configuration of learners' internal collaboration scripts. However, this principle has not yet been tested directly empirically. Therefore, we investigated whether the induction of different achievement goals (Dweck & Leggett, 1988) affects the selection/change (H1) and sequence (H2) of the scriptlets that students select during a collaborative task.

Regarding H1, we assumed that the induction of different kinds of achievement goals would affect the kinds of scriptlets learners select during collaboration. Based on a factor analysis, we were able to identify three factors according to which the scriptlets could be clustered: scriptlets that refer to cognitive learning strategies, scriptlets that refer to task-related activities, and scriptlets that refer to social learning strategies. On this basis, we distinguished the change in the learners' initial internal collaboration script and the actual activities reported in the posttest. However, none of these ANOVAs indicated significant differences with respect to the change in the selected activities between the learning goal and performance goal conditions. Consequently, the hypothesis that different kinds of achievement goals would have an impact on the selection of scriptlets must be rejected, at least on the basis of the evidence regarding H1. This may mean that the change regarding the kinds of selected scriptlets is quite resistant to induced goals (at least with regard to learning and performance goals). Moreover, this may again confirm rather mixed results with regard to performance goals or evidence that learning and performance goals could even correlate positively (Daumiller, 2023). However, a meta-analysis on goal induction (Noordzij et al., 2021) shows that to induce learning goals, it is important to relate this goal to a specific task (e.g., "While performing this task, it is your goal to… by …"). In comparison to this, the prompts used in our study may have been too vague. Thus, the goal induction may have been too weak at this point to have caused a change in the selection of scriptlets.

With respect to H2, however, and in contrast to the selection of scriptlets, the results of the ENA showed significant differences in the configuration of the scriptlets between the learning and performance goal conditions in the posttest. This means that the participants in the different conditions specified significantly different sequences of scriptlets. This partially supports our hypothesis and can be seen as evidence in favor of the configuration principle, at least regarding the differing sequence of scriptlets. Through ENA, we can see that particular activities are mentioned more frequently in a specific order by the groups. As described, learners with

pronounced learning goals are particularly motivated to engage in learning because they focus on improving their competence. In contrast, for learners with pronounced performance goals it is particularly important to demonstrate their performance or outperform others (Heyman & Dweck, 1992). Considering the scriptlets embedded in the network from this point of view, one explanation could be that some cognitive learning strategies (e.g., "scrutinize", "solve case", or "repeat notes") are more strongly integrated in line with the prompted goal condition, which also implies the acquisition of competence as the primary goal of the learners. In contrast, in the performance goal condition (which particularly emphasizes performance in comparison to others), many activities associated with a social context also play an important role (e.g., "help peer" or "read peer's analysis"). This might suggest very goal-specific configurations and seems to be in line with research on achievement goals pointing to their context specificity (Daumiller, 2023). However, this requires further analyses, which could possibly also account for the previously identified clusters of activities.

Limitations and conclusions

Of course, this study has limitations. First, it is important to note that students selected from a range of activities, which means that they were not free in their choice of scriptlets, as certain activities were already suggested to them. In contrast, however, it is quite conceivable that the students would also name other or further activities, possibly even more so if none were specified to them beforehand (Csanadi et al., 2021). Future studies could therefore include interviews, for example, to more validly capture script components and elicit their (re-) configuration more adequately (März et al., 2021). In this context, it is also important to emphasize that in the ENA, the initial internal collaboration script of the learners was not taken into account and therefore only the differences in the subsequently reported activities can be determined, but not in comparison to the initial internal collaboration script. Thus, it would also be worthwhile considering a more process-oriented approach and, for example, monitoring activities in real time in order to record the activities carried out as validly as possible. Furthermore, only scriptlets were examined as internal script components in this study. Thus, our data did not allow separating for different script levels. It is conceivable that learners already have had very heterogeneously elaborated scripts and therefore also responded differently to the external script (Kollar et al., 2007; Vogel et al., 2017). In this regard, the interaction of learners' internal script levels and/or prior collaboration skills and goals might be an interesting research gap to look at in future studies.

Another limitation is that we only manipulated two (achievement) goals in this study. In fact, there are many different kinds of achievement goals learners may have that could also be taken into account (e. g., avoidance goals; Daumiller, 2023). On top of that, research on achievement goals not only suggests that goals can be very situation-specific, but learners can also pursue multiple goals. This might also indicate that different and multiple goals might be particularly important in different collaboration scenarios (e.g., relational goals). Future research should therefore also include or control for further goals of the learners.

Nevertheless, the results of the ENA indicate that learners' internal collaboration scripts are configured differently depending on the induction of learning or performance goals. These results support the SToG's configuration principle that learners' internal scripts are configured depending on (situational) goals. This constitutes an important step in the empirical validation of the model and contributes to our understanding of internal collaboration scripts. A closer look at the scriptlets also provided further insight into how certain activities are configured depending on specific goals. The fact that there are significant differences in the sequence, but not in the change of the selected scriptlets, might indicate that the learners' internal script should be examined on a rather fine-grained level. The manipulation of goals resulting in differences in learners' internal collaboration scripts highlights the importance of integrating motivational prompts in CSCL. For example, teachers may want to integrate prompts that target specific goals into the design of CSCL environments, possibly leading to script configurations and activities that are particularly conducive to student learning. Especially in the context of CSCL, the adaptability of digital technologies should be utilized, for example, by offering different goal settings to the instructors, for instance, specific competence-related goals. The study thus holds important implications regarding the design of CSCL-environments and provides stronger evidence for the SToG configuration principle.

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