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CSsCL: the performance of collaborative learning

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Abstract
This article discusses the integration of three concepts central to the enterprise of computer-supported collaborative learning: namely, collaboration scripts, self-regulation, and group awareness. It does so through consideration of five reports in this Special Issue that address the integration challenge. Various themes are extracted and proposed as important to the field. These include the layered nature of self-regulation (meta-metacognition) and the layered nature of group awareness (trait-state-action). The theatre metaphor implied by the term 'collaboration script' is taken seriously here and is elaborated. It is shown to afford an extended and richer conceptualisation of scripted collaborations, developing the significance of direction, production, and audience. The features characterising this model of collaboration-as-performance reinforce an imperative for locating episodes of scripted collaboration within the broader eco-system of classroom practice.

This article is a commentary on five papers that make up the present Special Issue of ijCSCL. Their authors took up an invitation to integrate a set of concepts that are central to the journal's agenda: namely, collaboration scripts, self-regulation, and group awareness. My commentary starts by discussing each of these concepts in turn: reflecting on their significance to the field and why their integration is an active concern. I then turn to the papers chosen for publication here – four empirical and one theoretical – to consider how the three nominated concepts are approached when researchers strive towards their possible integration. Finally, I sketch a perspective of my own, as it arose through reading this interesting set of papers: a kind of integration of the integrations. These thoughts include special attention to one conceptual possibility that is invited by 'scripting': namely, to consider collaboration in 'performance' terms.

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Three foundational concepts

Collaboration scripts

Arrangements for learning collaboratively involve two or more individuals purposefully acting to construct shared understanding. In educational contexts, the goals set for working together in this way can be many and varied. So sometimes the goal assigned for a collaboration may be pre-defined and circumscribed: as when a problem is to be solved together or an artifact is to be designed together. But goals may also be more open-ended: as when a text is to be collaboratively interpreted or a lecture collaboratively discussed. There are now many strands of social science theory that recommend collaboration as a potent and versatile educational practice. In short, theory declares it to be a procedure that should support effective learning. Moreover, beyond the classroom, confidence in building knowledge with others is commonly identified as a key "21st century skill".

In spite of imperatives for encouraging student collaboration, teachers are aware that arrangements for joint study can be precarious. Educational research has confirmed this by reporting mixed outcomes for collaborative learning interventions (Barron, 2003; Chang and Brickman, 2018; Nokes-Malach et al., 2015). Such findings often reveal that learners (especially young learners) do not mobilise those discursive resources prescribed as most effective for making progress. In any given context of collaborating, such a finding may be interpreted in various ways. It may imply that the necessary social resources are not available to participants, or that the participants may not recognise their context requires them, or that their motivation to exercise them may be lacking. All such possibilities suggest collaborative learning, or 'classroom collaboration', is something for which students will often require support and direction.

One approach to providing such support has involved the '*scripting'* of collaborative learning. Admittedly the consistent definition of such a script has proved troublesome (Kollar et al., 2006) but, in general, 'scripting' involves structuring a joint activity such that participants are externally prompted with possible options for action. These prompts may, for example, be about requesting information from others, checking for shared agreement, summarising progress, anticipating obstacles, and so on. Moreover, such prompting may be associated with certain 'roles': specific responsibilities that are assigned to participants as part of the scripting.

In sum, designs of this general sort can be implemented to guide joint activity during an occasion of shared knowledge building. But such designs are also conceived as resources that might cultivate collaboration as a *general* competence. Therefore, in relation to both the management of specific tasks, but also the management of collaboration in general, it is hoped that engagement with these scripting frameworks will lead towards a process of appropriation – or the creation of 'internal scripts' (Fischer et al., 2013; Vogel et al. 2017).

Self-regulation

The idea of a script presupposes that knowledge building is an activity requiring regulation. An experienced learner will apply rules or principles judged to 'fit' the current circumstances of some unfolding learning task. Such task regulation may be required in relation to a number of psychological domains. There will be regulation within the *cognitive* domain,

whereby resources of attention, memory, prediction, synthesis, etc., get appropriately exercised. While in the motivational domain, the individual may need to regulate their *attitude* towards the task – especially if they experience a lack of spontaneous engagement. Moreover, in a context of *joint* activity, the individual will also be required to regulate the *emotional* and *interpersonal* dynamic of co-presence – in the interest of effective coordination with others. All those above demands that arise during a collaboration could benefit from the resource at issue here - an externally offered 'script'.

Scripting may help when collaborating individuals are themselves limited in their capacity to regulate the cognitive, motivational, social, and emotional aspects of a shared activity. There will be judgements they need to make within each of those domains (Hadwin et al., 2018). In short, the individual must monitor the evolving group activity and match their awareness of this to decisions about appropriate regulatory input. Such reflective oversight is typically termed 'metacognitive'. This does not imply that the psychological domains to be regulated are themselves only cognitive. So, for example, the emotional and interpersonal domains may also require regulation – but the task of their strategic oversight is itself still a cognitive one. The vocabulary of this self-regulation fits comfortably with that of metacognition. In any context of learning, we hope individuals will not be acting blindly towards the substantial elements of their set task. Rather, we hope they will be carefully regulating their recruitment of appropriate analytic resources. Doing so effectively will involve them in constructing a generative overview of their activity. It is often supposed that such self-regulation is one competence that might be well cultivated within learning episodes that are co*llaborative.* Unsurprisingly, such hopes have given encouragement to the development and application of collaboration scripts.

Group Awareness

Successful outcomes from a collaborative learning episode must depend, in part, upon skilful regulation of the interpersonal dynamic that will exist within the collaborating group. The concept of 'group awareness' identifies two factors that underpin such regulation. The first acknowledges that groups have a corporate identity residing in their history and composition. The members convened will have differing personalities; relationships may have been established between them elsewhere; previous interactions may be salient in memory. All this could be relevant to understanding the dynamic that obtains when a group orients to a shared classroom task. An alert participant may therefore reflect on these structural (or 'macro') features of their group, and then act according to the implications of this knowledge. Moreover, such awareness may arise in regulating the second (more micro) level of 'group awareness'. This refers to those transitory judgements involved in the to-and-fro of interpersonal interaction: judgements arising from the moment-to-moment demands of an evolving social exchange.

In short, group awareness calls both upon a mindfulness in relation to the character of a group, but also a requirement to manage those fleeting interactions that continuously occur among its members at work. Such social intelligence equips learners for acts of self-regulation: although social intelligence may also be a competence that is itself cultivated through experience with collaboration scripts.

The view from five papers

The three target concepts discussed above were nominated by the journal as central to the concerns of computer-supported collaborative learning – and so deserving of further integration. The present special issue of ijCSCL comprises five papers that illustrate ways of addressing this challenge, both empirically and theoretically. My aim in this reflection is not to critically review those papers, but to extract what I believe are key points: thereby illustrating the range of ways in which research can approach these challenges. Taken together, there exists within each paper a shared interest in understanding what makes collaboration scripts work. In various ways they inquire how the successful outcomes of a collaborative task can be influenced by intervention designs that orchestrate participant involvement. We find that these studies dwell, first, on the collaboration demands of different educational tasks and, second, on design options for the configuration of scripts supporting collaboration within such tasks. However, while the presence of others can assist individual learners in their cognitive regulation, the social and participative mix can itself be the target of active regulation. Accordingly, several of these papers also address this theme.

Five papers

Kielstra et al. (ibid.) considers whether scripting can support effective regulation of a reading task. Reading-for-learning offers an interesting practice for CSCL research. This is because it is typically a form of study that we expect to be pursued alone: in other words, the reading act itself is not naturally collaborative. But Kielstra et al. illustrate how the regulation of such a private learning task might still be incorporated within the design of a collaborative script. This requires that solitary reading is set between opening episodes of collaborative planning and concluding episodes of collaborative review. Such scripting is reported here to be effective in shaping a group's regulative activity, although only "low-level" regulation.

Zimmerman and Land (ibid.) consider whether collaborative scripting can influence domain knowledge when incorporated in a technology that supports students' learning on a field trip. A contrast built into the research design allowed differences in scripting configuration to be evaluated. The study is distinctive for demonstrating how scripting can be successful in the more volatile circumstances of mobile and outdoor learning. This research design is perhaps also a reminder that the meaning of the term "computer" in CSCL can be quite generous: certainly collaborative scripting can be hosted on smartphones and (as here) mini tablets.

Vogel et al. (ibid.) raise several issues relating to the refinement of collaboration script design. A central concern here is with how a script might be made *adaptive*: that is, made more intelligently tuned to the uncertain path of a collaboration. This study by Vogel et al. incidentally prompts the reader to recognise that organising in-task (including 'adaptive') guidance for computer supported learning systems is already a well-established practice outside of CSCL. The terminology traditionally favoured in describing such 'intelligent tutoring systems' might refer to guidance in terms of 'prompts' or 'scaffolds', rather than 'scripts'. However, implementing guidance in *collaborative* learning systems is a greater challenge because that guidance (or scripting) must relate to the social (rather than just the curricular) dimension of the learning: learner activity in the social domain is harder to model than learner activity in the curriculum domain. Vogel et al. therefore socialise a script

by passing over its management to the learners themselves. Guidance is available to them in either minimal or maximal detail, and so these learners can decide (i.e., render adaptive) which level of support they invoke. This study furnishes an additional illustration regarding method: namely, how the guidance provided by scripts can go beyond the familiar form of 'discourse prompting' (a condition in their study) and include 'worked examples' as an alternative format for support. In the end, their notion of learner agency is shown to be a feasible basis for designing adaptive guidance in a collaborative script. But here such guidance only impacted regulatory actions among those students who started the project with more advanced self-regulation skills.

Schnaubert and Bodemer (ibid.) provide a conceptual analysis of 'group awareness'. Given a research tradition that tends to focus on scripting *cognitive* regulation, these authors remind us how collaborators must also act to manage *social* factors that operate in episodes of group learning. They propose a framework identifying six "defining aspects" of group awareness as it relates to the regulation of joint activity. Whether or not their distinctions are adopted to circumscribe the concept, it is a framework that invites educational designers towards productive connections with adjacent disciplines: particularly those within cognitive and social psychology.

Rojas et al. (ibid.) report the design of a game-based collaboration script for elementary-age learners. The gamified nature of the collaborative learning allows for scripting based on the assignment of in-game roles. Moreover, since such games offer their users a continuous overview of what others are doing, they may promote a strong sense of group awareness. This approach offers a distinctive route towards understanding the significance of such awareness. However, what is of particular concern to this research is the disappointing outcome exeperiences often reported for collaborative learning episodes. The relevant factor addressed here was the *attitude* that students may bring to the general practice of collaborating, as well as to some particular occasion of such collaboration. Outcomes may be constrained by participants' unwillingness to engage with a learning practice that is felt to be unwelcome. There may be many reasons for such reluctance: the study by Rojas et al. aims to determine whether such attitudes can be shifted by group activity that incorporates a collaborative script. Their findings suggests that it can.

On regulation: meta-metacognition

Several of these papers invoke a vocabulary of 'macro' and 'micro' features when explaining task-regulating practices. This suggests that regulation involves a more complex psychological architecture than that captured by reference to a totalising 'metacognition'. If so, then cognition labelled 'meta' deserves to be more fully systematised in terms of its granularity. At the same time, the vocabulary in these papers also includes frequent reference to 'layers' and 'depths' of collaboration. The rules for applying these distinctions are not always clear but they seem related to another terminology in use here: namely the prefixes of 'macro' and 'micro'. Where such distinctions might be useful deserves closer discussion: I do this here by considering next a hypothetical example of regulation in action – first in relation to 'layering' and then to 'depth'.

Reading a text offers an iconic example of educational practice. It is a routine task assigned to learners, even when they are studying in collaborating partnerships (cf. Kielstra et al., ibid.; Vaughn et al., 2011). However, for simplicity we consider here the analytic

choices a reader might make when reading alone. A text may be approached in a variety of ways that, together, would be termed 'cognitive' (Paris et al., 1983). First, this could involve how attention is distributed across that text: for example, it might be skimmed wholesale, or certain sections might attract closer examination than others, headings might be selectively sought, bibliographies parsed, and so on. Beyond which, such attentional choices may be reinforced by further cognitive practices whereby the reader extracts and elaborates meanings found in the text. In doing this, a reader may construct self-explanations, develop hypotheses, or reflect on the text's authority, provenance, and ownership (Cain et al., 2001). These examples of interpretation may be exercised internally – i.e., cognitive processing in the classic sense. However, such 'acts of inquiry' may also be undertaken by the reader using different and external analytic toolsets. For example, analysis might employ textual manipulation tools. The reader may render the text plastic by cut and paste operations or by the insertion of coloured highlighting, or notes in a margin. Alternatively, annotation practices may be developed outside of the text: creating a separate document for re-constructing the outcomes from private reading acts. Or as a further example, the analytic toolset may be social-interactional. In that case, the whole repertoire of 'inquiry reading' could be launched as a *social* practice: it thereby becomes a collaborative enterprise in which participants negotiate and share the analytic effort.

In this reading example there is a sense of an actor's cognitive investment being potentially 'layered'. What may appear as a core set of analytic choices (skimming, highlighting, self-explaining etc.) are acts that are potentially distributed (and perhaps extended) within local material and socio-cultural spaces. Moreover, activity may be hierarchically organised or nested within these spaces – which reinforces the notion of 'layering' as a helpful descriptor. Metacognitive effort is exercised in managing a chosen analytic 'layer' (such as in-text annotation, concept mapping, social discourse, etc.) but the strategic recruitment and organisation of these 'layers' also requires management effort. In short, such a 'portfolio' of regulation layers needs itself to be regulated. So perhaps it is tempting to invoke 'meta-metacognition'. Yet doing that surely has a 'down the rabbit hole' feel to it. Instead, case studies of student inquiry or construction (whether it is collaboratively organised or not) might first work to make visible such a distributed architecture of regulation. In this spirit, research strategy would strive to identify the layers of regulation that are possible in a given context of learning: revealing those that are favoured and then the learner engagements and outcomes that follow from them.

However, the macro/micro language variously employed in the present set of papers seems to be only in part about how regulation practices are *distributed* in this layered sense. For some authors the same macro/micro language can refer to regulation practice in terms of its sophistication: perhaps suggesting that a given regulating move might usefully be characterised in terms of its 'depth'. This simply acknowledges that what gets said to a collaborating partner can vary according to how effectively it advances the trajectory of their current task. If the regulation of tasks is also to be characterised on this dimension of depth, then what questions arise for research to follow?

Simply taxonomizing the relevant collaborative talk in these terms might seem a natural starting point. However, the present set of studies illustrate how coding the discourse of task management is not easy. It may require researchers to consider more than the surface features of individual utterances. This is because the reliable coding of an utterance's illocutionary force requires attention to the *history* of the interaction in which that utterance

occurs. An individual's meaning may be heard by a partner in terms of a shared understanding of what has come before. Moreover, our coding may be rendered still more challenging if partners interpret each other by drawing from a history of communicating that proceeds the present moment. Meanings may be derived from discourse experienced prior to the particular occasion that is currently the subject of study. In short, such considerations imply closer attention to the nature of mutuality variously constructed by collaborators. This is more the topic of the following section.

Awareness within groups

Several of the studies reported in this issue wrestle with the problem of how collaborators 'read' the group they are in. This is explored here most fully by Schnaubert and Bodemer (ibid.). Their paper centres on a six-part framework for conceptualising 'group awareness', but this is complemented by a wider discussion of how the dynamics within collaborating groups can be researched. That discussion revolves around two social psychological approaches that can underpin such efforts.

The first might draw from what is termed a 'social cognition' tradition. It acknowledges a strong human motive to make sense of those social configurations that people are part of. This includes groups they may have chosen to join but also those to which they find themselves allocated (Frith and Frith, 2012; Smith and Semin, 2007). Even though the groups formed within CSCL research may be transitory, they are likely to become the objects of such social cognition for their members. A more colourful way of expressing this is to say that participants in a collaborating group will become 'theorists' of that group. Then, even exercising only a modest theory of how one's group and its members function can influence how an individual acts within it. Such influence could operate on the energy and thought that members invest in responding to scripted prompts. In this way, active social cognition is a force that shapes collaboration outcomes. Yet it is a force whose nature cannot be easily extracted from the records of group interaction.

One approach to such analysis is that adapted here by Rojas et al. (ibid.). After the classroom intervention, participants discussed with researchers their experience of being in a collaboration. In the example of that project, student reflections concerned their general feelings about classroom learning organised for groups (as with their own intervention). Of the four empirical studies reported here, only Rojas et al. pursued a social cognition theme in that way. Yet such post-intervention conversations could enrich our understanding of how collaborating students develop and deploy their group awareness. It is true, as Schnaubert and Bodemer (ibid.) pointed out, that such 'after the fact' disclosures may not easily inform our analysis of events occurring during the actual group activity. This is because the way individuals interpret their actions or experiences afterwards does not promise that the processes invoked were active at the time. Nevertheless building a corpus of such reflective material (particularly if triangulated with group interaction records) could greatly advance understanding of the social cognition in group awareness (Stahl and Hakkarainen, 2021).

The second psychological approach necessary for studying collaborative group dynamics is more micro-analytic. It is focussed on understanding the nature of social interaction during the moment-by-moment process of collaborating (Miyake & Kirschner, 2014). Researchers will hope that those prompts in the scripts they design do not simply evoke mechanical responses from collaborators. Instead, the responses that are sought should have

that quality of 'depth' that was referred to above. Although, as also noted earlier, the coding of such responses can be difficult: because the meaning of any individual utterance may be constructed from events long proceeding the moment it occurs. Nevertheless, attention to interaction at this level is important and, usefully, two of the studies reported here present data of this kind (Kielstra at al., ibid.; Zimmerman and Land, ibid.).

Often such analyses of group interactions are seeking a dependent variable that can be related to aspects of the collaborative scripting. That variable might be constructed by researchers from some number of coding categories defined to complement the regulating intent behind their scripting. This is fine, because valuable relationships can surely be revealed this way. But we also need analyses that are rooted in broader social interactional theories. In this regard, human intersubjectivity may provide a helpful starting point – particularly if adopting the ways that it has been pursued within developmental psychology (Forman, 1992; Baker et al., 1999). Intersubjective processes manage the mutual understanding that can exist between people in relation to their individual psychological states. To put it simply, in a situation of us sharing some activity, intersubjectivity resources you to understand my thinking at a given moment: but it can also allow *me* to understand that you have this knowledge. Such hall-of-mirrors mutuality can thus be recruited to support regulation of our common purposes. Whether or not human beings are *unique* in their access to this psychological resource is a matter of debate. But it surely is the case that human beings exercise intersubjectivity with determination and intent from an early age. Moreover, one arena in which it plays a powerful role is the coordination of collaborative activity (Crook, 1994).

The identification of intersubjective effort within an exchange is a challenge for researchers. This is because inferences of its presence and its influence demand very close analysis of collaborative engagement, including the interdependencies between turns that are made within joint activity. Yet such an approach is available to researchers; it exists in the form of Conversation Analysis (Goodwin and Duranti, 1992; Koschmann, 2013). In a scripted collaboration, if depth of regulation exists within group awareness, it may be best identified by applying conversation analysis to the interactions that the script supports.

CSsCL: the theatre of collaboration

The topic considered in the present set of papers is 'computer-supported scripted collaborative learning'. "CSsCL" is an acronym invented here to reflect that concept. But do we need more of these acronyms – particularly ones that are five characters long and unpronounceable? I often find with acronyms, at least when reading scholarly text, that their meaning gets forgotten, such that frantic scrolling back is required. But the "s" in CSsCL has some merit. It alerts an interest in scripting, but it also neatly bisects the two matters of interest - computer support and collaborative learning – and thereby creates a visual pattern that is memorable. However, a less whimsical justification resides in the sheer ubiquity of scripting for collaborations organised at or around technology. This reflects how the original 'roles-and-prompts' sense of scripting has broadened out. For example, Weinberger et al. (2008) propose that a script design is implied in their case of a hypothetical lecturer distributing teaching resources between a lecture and an online environment. Such broadening is a trend reflected in the set of papers published in this Special Issue. For example, Zimmerman and

Land (ibid.) include an observational checklist as a script (along with three assigned roles). While Rojas et al. (ibid.) propose that the action constraints characteristic of a computer game can define a format for scripting. These uses may be generous when set against early definitions of collaboration scripts. But as long as we know how terminology is being used, referring to a 'script' can serve to describe a variety of supports that are put in for the benefit of collaborating learners. Certainly, care should be taken not to use the term 'script' as "just a trendy word to refer to lesson plans" (Dillenbourg and Jermann, 2007, p 286). But what this warning urges is that the core activities of 'scripting' should be distinguished "… from the didactic envelope, that encloses the core activities into other activities" (op. cit., 286). The formula "CSsCL" can be helpful. Unpacked, it can signal that scripting has been made integral to some research question directed at individuals collaborating in a digitally resourced context.

More importantly, the heading above the present section intends to remind us how the vocabulary of CSsCL freely recruits the metaphor of theatre. It was made explicit here in the framing of studies by Kielstra et al. (ibid.) and Vogel et al. (ibid.). Elsewhere it has been more fully articulated by Fischer et al. (2013). Those authors cite the implementation of a group wiki design as an example of a 'play' in a CSsCL context. What follows is that such a play will comprise a number of 'scenes' (for example, designing the wiki template, researching the topic, ordering the sections, disseminating the final product). Different 'scripts' are then made available within each scene. These scripts will manage the interaction between collaborators/actors who play the various 'roles' set for the learning/drama. The risk of such metaphors is that they import inappropriate (and perhaps unwanted) expectations into the cultural practice they are designed to explain or enrich. For example, Weinberger et al. (2008) grant that: "Different from theatre scripts, external collaboration scripts are to guide and scaffold rather than impose learners' collaborative activities" (158). In this remark one danger of the metaphor is nicely illustrated. The imposing force of a theatre script might encourage the view that cultivating more confidence in collaborators requires a script that would mechanically drive their joint activity. Such perspectives might also encourage educational designers towards the "over-scripting" of collaborations (Dillenbourg, 2002).

So, elaborating a metaphor around some educational practice can risk misguiding its direction of travel. But elaborated in other ways, the same metaphor may also be usefully provocative. A slippery metaphor might act as a tool to think with: suggesting steering directions of travel in ways that had been neglected. For example, by considering collaboration as a play, it would thereby become possible to concentrate on it as being a 'performance space' rather than as a fixed container or host for a script. By taking this approach, what themes are suggested when the theatre metaphor encourages theorising collaboration in *performance* terms? Here I suggest three headings under which this question might be pursued: direction, production, and audience.

Directing collaborative performance

Good theatre scripts are not executed, they are performed. This modest insight invites extensions to the case of scripts devised for classroom collaboration. The main thing that lifts a playscript from (mere) 'execution' to (vivid) 'performance' is sensitive direction. Certainly, some playwrights may be explicit and constraining about what needs to be said and done on the stage (e.g., Harold Pinter). But even their work will be subjected to the interpretations

of a director (e.g., for Pinter, by micro-managing the pauses and paralinguistic detail). What actors and directors do together to work with a script is well illustrated by rehearsal recordings[1]. It can be a struggle of negotiation around even quite detailed features of what the text provides. For example, consider how the use of emphasis renders differently Hamlet's comment: "There are more things on heaven and earth, Horatio, than are dreamt of in your *philosophy*" versus "There are more things on heaven and earth, Horatio, than are dreamt of in *your* philosophy." Meanings of that sort need to be *found* in scripts, so that they can be performed as drama. What, therefore, is implied by adopting this 'performance' theme for theorising the scripting of collaboration episodes in classrooms?

It helps to think through how some of the present analogies work in the two contexts. Certainly, there are roles in a play and there can be roles in a collaboration. However, the scripted turns provided for the two kinds of role-takers evidently work in a different way. While the text of a play offers a scripting that seems circumscribed and comprehensive, the text of a classroom collaboration offers a scripting that is skeletal – a set of mere affordances or prompts for shaping the speech and actions of others. Yet this skeletal or scaffolding quality of scripts can also operate in theatre. For example, in the plays and films of Mike Leigh. Often his characters will be given the outline of script and the arc of a narrative – sometimes direction amounting to no more than an account of who they are as a character. Then the emergence of a performance 'scripted' in that limited sense resides in the craft of the actors working with a director. Yet it is important to stress that the performance conception of CSsCL is not limited to the case of improvisational theatre (Frost and Yarrow, 2007). Just as a given dramatic script must be interpreted by its actors, so a collaboration script must be interpreted by (performed by) its learners. Nevertheless, what is currently missing from importing such 'script work' into the classroom is the shadowy presence of the director role.

Pursuit of this metaphor places teachers in the role of directing students' discovery of meaning in collaboration scripts – and thereby the performance of a productive joint activity. Although teachers will often work to orchestrate and monitor the collaborative tasks that they set for students (Gillies et al., 2008; Stein et al. 2008; Webb, 2009), research has rarely explored this form of 'direction' in relation to episodes of collaborative scripting – or, as expressed here, in relation to the 'performance' of that script. Yet the components of such a script surely offer a set of focal points for discussing what (supposedly) constitutes productive collaborating. The apparently simple 'lines' of a script ("find a counter-example", etc.) deserve some degree of sense making discussion before they become the basis of a performance. The script takes meaning from this effort of interpretation. What exactly is involved in this 'finding of a counter-example', and where is it supposed to take us in terms of our agreed goals? Moreover, the environments of *computer*-supported collaborations may be ideal for extending this form of preparatory direction into the flow of the joint activity itself – as illustrated by the example of a teacher dashboard designed for the monitoring of ongoing collaborations (Schwarz et al., 2021).

[1] For an example, see this video illustrating working on different interpretations of the same lines from 'Much Ado about Nothing' (as well as its illustration of the process of negotiation that underpins direction): https://www.youtube.com/watch?v=RTM09-l4eP0.

Producing collaborations

The analogy is somewhat slender, but both a play and a classroom collaboration are occasions that are 'produced' – in the sense that they are created as sharply-marked occasions on the evolving landscape of, respectively, entertainment and learning. If the production analogy is helpful, it is through casting the CSsCL researcher in this producer role. In many research reports of scripted collaboration (including some in the present set) it is left unclear how smoothly the occasion integrates with the teaching and learning routine into which it is nested. Sometimes students may approach the intervention as a welcome distraction from that routine – particularly if it involves an unfamiliar encounter with technology (cf. Rojas et al., ibid.). But these discontinuities may at other times be less welcome. In sum, they may have uncertain impacts on student engagement. For example, a negative impact might arise if the purpose of the intervention is not clear to participants, or if the demands it makes are too great. Equally, the discontinuity may be an agreeable distraction from classroom routine, particularly if it has a game-like design. When heightened engagement is the consequence, this may be welcomed by researchers. Yet it can limit conclusions made about impact – at least if judged through controlled comparisons with business as usual. The collaborative nature of a digitally-mediated intervention may be reported positively by its users (and/or engaged with vigorously), more because of its novelty status. It may remain uncertain how much outcomes actually arose from the simply welcome distraction of an unfamiliar or playful form of classroom activity.

The implication of production being an element within the performance metaphor of scripting centres on this management of a felt continuity with the routine of a learning environment. Evaluating the significance of an intervention is best made with attention to how it is understood by participants: how it is perceived in relation to their prevailing classroom or curricular context. Perhaps the ideal (but most challenging) way forward is research interventions that are sustained: in that way, outcomes would be studied across time as the designed activities become embedded in the prevailing context rather than bolted on to it.

Audiences of collaborative performance

Performances have audiences – whose appetites and prejudices need to be considered. The performance of a collaboration script can have at least two audiences. First, there are the researcher(s): they witness that performance in order to carry out a sense-making exercise of analysis on it. Second, there those like ourselves who read the reports of this analysis and whose appetite involves having findings clearly described. The present set of papers highlight the challenges that can exist in relation to both of these roles. I will briefly illustrate this for each of these performance 'audiences'.

A journal commentary of the present sort risks indulging a wide range of personal concerns about methodology and procedure. But I will only mention those that became prominent for me when viewing this particular set of studies – albeit a view through the lens of the performance metaphor. Two common analytic moves were well illustrated in this present set of studies. One was oriented to interpreting the reflections of students when invited to discuss their experience subsequent to participating in an intervention. The risks around invoking data of this kind link to comments made above about the 'producer' status of a researcher. We suppose that student participants are not dopes: they surely aim to make sense

of what classroom visitors (play producers) are really up to. They deserve an account of how and why the visitors are studying collaboration. This may sometimes be clearly explained to them, but such priming discussion is rarely taken seriously in procedural descriptions. However, one way or another participants are likely to construct a rough understanding of what the 'producers' seem to be interested in. In which case, after-the-event questions requiring user evaluation of that producer's intervention may carry a high risk of soliciting predominantly polite and calculated answers – perhaps concealing something more telling. That makes such exchanges a resource to be used with care.

The second common analytic move in CSsCL research is to characterise the quality of a collaboration through forensic attention to the structure of the participants' talk and actions. However, CSsCL is a research tradition that (typically) enters a classroom with a rich paraphernalia of procedure: technology, scripts, talk, 'directors', 'producers' and so on. As such, constructing an account of participants' experience through their recorded talk will be challenging – at least if it is to take heed of all the active relationships within this mix. The studies discussed here show diligence in describing coding that was negotiated to levels of respectable or high agreement. But reliability in the conduct of this difficult task is most useful when the codebook employed is fully declared and when it is explained as the only source for independent agents to make complementary judgements. The strength of any tool created to systematise these rich and complex exchanges is related to the ease with which it can be adopted by others – where those others are not party to local 'ways of seeing'. An ideal outcome would be consensus among strangers to that local research culture in which a codebook was first devised.

Yet there is another audience attending to the collaborative performance space: namely, those readers of the research reports that describe it. I found it difficult to fully understand some of the scripting and task designs reported in the present four studies. More generally, I often found it hard to project myself into the possible experience of participants. It was therefore harder to informally theorise what they might have thought or felt about what they were doing. This is not the fault of these authors. They had to struggle against the limitations of textual exposition. However, my concern is not simply the usual complaint that editors demand unreasonable brevity. High fidelity learning experiences need to be expressed in high-fidelity media. Certainly, the present authors were helped by the luxury of appendices. But more than this is needed, and more is possible. It would greatly improve reader engagement if the participant experience created by some CSsCL application was made accessible as a screencast. Although the ideal solution is to give access to software itself. The lack of such resources in educational publishing may not be the fault of publishers. When I edited a journal in this general field, I found the publisher was very willing to furnish web space in which such material could be placed. Yet invitations to authors to do so were never met with interest. For sure there will be copyright issues and, sometimes, there will be ethical issues, but this is one audience-friendly direction the CSsCL community should consider more often.

Conclusions

Engaging with the five papers published in this Special Issue of ijCSCL has provided this reader with a rich and welcome stimulus for thought – a reading experience that I predict

will be shared by others. The papers clearly establish the importance to the CSCL community of researching integrations of these three concepts. First, in relation to self-regulation, the present reports led me to reflect on the layered nature of this process. The activities of regulation can be distributed between sets of material and/or discursive practices. Regulation is exercised within such sets. But the sets themselves provoke opportunities for regulation – choices may be patterned between them. In this way the regulation is itself regulated.

Second, in relation to group awareness, the present research frames this in terms of both social cognition and intersubjectivity – although more explicitly drawing on the literature of those theoretical traditions would be welcome. The challenge to further understanding of the social realm seems to be one of more deeply integrating traits, states, and observable activities - perhaps in a manner exemplified by Tamir and Thornton (2018).

This reader was also struck in these reports by the breadth of meaning that can be given to 'script'. It might be pedantic to make too much of this. This is because it may not be a serious problem. A study deserves to claim alignment with a CSsCL tradition if it simply identifies some distinct form of collaborative support that has been made central to its research questions.

Finally, my reading here has encouraged me to take more seriously the theatre metaphor of a collaboration script – taking it beyond its normal rather limited application. Metaphors risk constraining our understanding, but they also can serve to extend it in unexpected and productive directions. This led me to consider a conception of collaborations as 'performances'. Such language may seem risky if we associate it with expressions of the sort: "but he did make such a performance of it". Yet it is this "making of a performance" that could be important when cultivating a student's confidence in situations of collaborative learning. The elements of a collaborative script bring the roles and opportunities of shared thinking firmly and helpfully into shared focus. A degree of such participant self-consciousness when placed into a collaboration – i.e., making a bit of a performance of it – need not then be a bad thing. At least not if such self-awareness nurtures forms of collaboration practice that are more spontaneous and more owned. In striving towards such ends, the discussion above has stressed the supporting roles and responsibilities of 'directors' and 'producers'. The theatre metaphor deserves exercise if it creates attention to the variety of ways those individuals might come together around collaborative scripting. For it is through the extension of their active engagements with CSsCL interventions that such projects can be more fully integrated into the eco-system of teaching and learning.

References

Baker, M., Hansen, T., Joiner, R., & Traum, D. (1999). The role of grounding in collaborative learning tasks. *Collaborative learning: Cognitive and computational approaches*, 31, 63

Barron, B. (2003). When smart groups fail. *The Journal of the Learning Sciences*, 12(3), 307–359. https://doi.org/10.1207/S15327809JLS1203_1

Cain, K., Oakhill, J. V., Barnes, M. A., & Bryant, P. E. (2001). Comprehension skill, inference making ability, and the relation to knowledge. *Memory and Cognition*, 29, 850–859. https://doi.org/10.3758/BF03196414

Chang, Y., & Brickman, P. (2018). When group work doesn't work: Insights from students. *CBE—Life Sciences Education*, 17(3), https://doi.org/10.1187/cbe.17-09-0199

Crook, C. (1994). *Computers and the Collaborative Experience of Learning*. London and New York: Routledge. https://doi.org/10.4324/9781315122519

Dillenbourg, P. (2002). Overscripting CSCL: The risks of blending collaborative learning with instructional design. In P. A. Kirschner (Ed.), *Three worlds of CSCL. Can we support CSCL?* (pp. 61–91). Heerlen: Open Universiteit Nederland

Dillenbourg, P., & Jermann, P. (2007). *Designing integrative scripts. In Scripting computer-supported collaborative learning* (pp. 275–301). Boston, MA: Springer. DOI: https://doi.org/10.1007/978-0-387-36949-5_16

Fischer, F., Kollar, I., Stegmann, K., & Wecker, C. (2013). Toward a Script Theory of Guidance in Computer-Supported Collaborative Learning. *Educational Psychologist, 48(1), 56–66.*https://doi.org/10.1080/00461520.2012.748005

Forman, E. A. (1992). Discourse, intersubjectivity and the development of peer collaboration: A Vygotskian approach. In L. T. Winegar, & J. Valsiner (Eds.), *Children's development within social contexts: Metatheoretical, theoretical and methodological issues* (1 vol., pp. 143–159). Hillsdale, NJ: Erlbaum

Frith, C. D., & Frith, U. (2012). Mechanisms of social cognition. *Annual Review of Psychology*, 63, 287–313. https://doi.org/10.1146/annurev-psych-120710-100449

Frost, A., & Yarrow, R. (2007). *Improvisation in Drama*. New York, NY: Palgrave Macmillan

Gillies, R. M., Ashman, A., & Terwel, J. (Eds.). (2008). *The teacher's role in implementing cooperative learning in the classroom: An introduction*. New York: Springer. ISBN: 978-0-387-70892-8

Goodwin, C., & Duranti, A. (1992). Rethinking context: an introduction. In C. Goodwin, & A. Duranti (Eds.), *Rethinking context: language as an interactive phenomenon* (pp. 1–43). Cambridge, UK: Cambridge University Press. https://doi.org/10.1177/096394709500400105

Hadwin, A., Järvelä, S., & Miller, M. (2018). Self-regulation, co-regulation, and shared regulation in collaborative learning environments. In D. H. Schunk, & J. A. Greene (Eds.), *Handbook of self-regulation of learning and performance* (pp. 83–106). Routledge/Taylor & Francis Group

Kielstra, J., Molenaar, I., van Steensel, R., & Verhoeven, L. (ibid). Supporting socially shared regulation during collaborative task-oriented reading. *International Journal of Computer Supported Collaborative Learning.*

Kollar, I., Fischer, F., & Hesse, F. W. (2006). Collaboration scripts–a conceptual analysis. *Educational Psychology Review*, 18(2), 159–185. https://doi.org/10.1007/s10648-006-9007-2

Koschmann, T. (2013). Conversation analysis and collaborative learning. In C. E. Hmelo-Silver, C. Chinn, C. K. K. Chan, & A. O'Donnell (Eds.), *The international handbook of collaborative learning* (pp. 149–167). New York: Routledge

Miyake, N., & Kirschner, P. (2014). The social and interactive dimensions in collaborative learning. In R. K. Sawyer (Ed.), *The Cambridge handbook of learning sciences* (438 vol., p. 418). New York: Cambridge University Press. https://doi.org/10.1017/CBO9781139519526.026

Nokes-Malach, T. J., Richey, J. E., & Gadgil, S. (2015). When is it better to learn together? Insights from research on collaborative learning. *Educational Psychology Review*, 27(4), 645–656. https://doi.org/10.1007/s10648-015-9312-8

Paris, S. G., Lipson, M. Y., & Wixson, K. K. (1983). Becoming a strategic reader. *Contemporary Educational Psychology*, 8(3), 293–316. https://doi.org/10.1016/0361-476X(83)90018-8

Rojas, M., Nussbaum, M., Guerrero, O., Chiuminatto, P., Greiff, S., Del Rio, R., & Alvares, D. (ibid). Integrating collaborative script and group awareness to support group regulation and emotions towards collaborative problem solving. *International Journal of Computer Supported Collaborative Learning*

Schnaubert, L., & Bodemer, D. (ibid) Group Awareness and Regulation in Computer-Supported Collaborative Learning.International Journal of Computer Supported Collaborative Learning

Schwarz, B. B., Swidan, O., Prusak, N., & Palatnik, A. (2021). Collaborative learning in mathematics classrooms: Can teachers understand progress of concurrent collaborating groups? *Computers & Education*, 165, 104151. https://doi.org/10.1016/j.compedu.2021.104151

Smith, E. R., & Semin, G. R. (2007). Situated social cognition. *Current directions in psychological science*, 16(3), 132–135. https://doi.org/10.1111/j.1467-8721.2007.00490.x

Stahl, G., & Hakkarainen, K. (2021). Theories of CSCL. *International handbook of computer-supported collaborative learning* (pp. 23–43). Cham: Springer. DOI: https://doi.org/10.1007/978-3-030-65291-3_2

Stein, M. K., Engle, R. A., Smith, M. S., & Hughes, E. K. (2008). Orchestrating productive mathematical discussions: Five practices for helping teachers move beyond show and tell. *Mathematical thinking and learning*, 10(4), 313–340. https://doi.org/10.1080/10986060802229675

Tamir, D. I., & Thornton, M. A. (2018). Modeling the predictive social mind. *Trends in cognitive sciences*, 22(3), 201–212. https://doi.org/10.1016/j.tics.2017.12.005

Vaughn, S., Klingner, J. K., Swanson, E. A., Boardman, A. G., Roberts, G., Mohammed, S. S., & Stillman-Spisak, S. J. (2011). Efficacy of collaborative strategic reading with middle school students. *American educational research journal*, 48(4), 938–964. https://doi.org/10.3102/0002831211410305

Vogel, F., Kollar, I., Reiss, K., & Ufer, S. (ibid). Adaptable scaffolding of mathematical argumentation skills: The role of self-regulation when scaffolded with CSCL scripts and heuristic worked examples. *International Journal of Computer Supported Collaborative Learning.*

Vogel, F., Wecker, C., Kollar, I., & Fischer, F. (2017). Socio-cognitive scaffolding with computer-supported collaboration scripts: A meta-analysis. *Educational Psychology Review*, 29(3), 477–511

Webb, N. M. (2009). The teacher's role in promoting collaborative dialogue in the classroom. *British Journal of Educational Psychology*, 79(1), 1–28. https://doi.org/10.1348/000709908X380772

Weinberger, A., Kollar, I., Dimitriadis, Y., Mäkitalo-Siegl, K., & Fischer, F. (2008). Computer-supported collaboration scripts: Theory and practice of scripting CSCL. *Technology-Enhanced Learning. Principles and Products* (pp. 155–174). Berlin: Springer

Zimmerman, H. T., & Land, S. M. (ibid) Supporting children's place-based observations and explanations using collaboration scripts while learning-on-the-move outdoors. *International Journal of Computer Supported Collaborative Learning.*