Promoting interaction in online distance education: designing, implementing and supporting collaborative learning

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Abstract

Purpose – Against the background of empirical research on computer-supported collaborative learning (CSCL), the purpose of this paper is to advocate implementing collaborative learning activities into online distance education courses to engage learners in interactive knowledge construction. This study uses empirical evidence to illustrate how educators can integrate collaborative learning and designated collaboration support into their instructional design.

Design/methodology/approach – This study presents a general review of research literature from the field of CSCL to highlight productive interaction between learners as key learning mechanisms, summarize core features of collaborative tasks, which promote interaction between learners and present group awareness tools and collaboration scripts as two complementary approaches to support groups during collaborative learning.

Findings – Empirical research suggests that collaborative learning is an effective learning activity and that incorporating collaborative learning into online courses benefits learners in terms of learning and social aspects such as social presence. However, to leverage the potential of collaborative learning, careful instructional design that promotes productive interaction between students is necessary.

Originality/value – This paper provides an overview on the topic of collaborative learning and how meaningful interaction between learners can be fostered. Specifically, this study details how collaborative tasks can be designed and how collaboration support can be used to provide students with opportunities for interaction that fosters acquiring new domain-specific knowledge as well as collaboration skills. To allow educators to design and incorporate collaborative learning activities into their own online teaching, the authors provide a theoretical basis for understanding the mechanisms behind effective collaborative learning as well as examples and practical considerations.

Keywords Instructional design, Collaborative learning, Interaction, Distance education, Online education, Computer-supported collaborative learning (CSCL)

Paper type General review

Introduction

Active participation during learning activities and even more so interaction between learners are essential for learning (Chi and Wylie, 2014). Though this is true for learning in
both face-to-face and online settings, one additional benefit of interacting with others online is that interaction fosters social presence (Kim et al., 2011), that is, learners’ perception of having contact with “real” people (Aragon, 2003). Social presence, in turn, is positively associated with satisfaction and retention in online courses (Levy, 2007; Richardson et al., 2017). Against this background, teachers might want to consider incorporating collaborative learning into their online courses to promote interaction between learners within their online courses.

In this article, we present theoretical and empirical foundations, as well as practical suggestions that empower educators to incorporate collaborative learning activities into their online teaching. We do so by referring to our own research as well as the broader literature on computer-supported collaborative learning. Particularly, we characterize collaborative learning and outline the role of productive interaction for learning, summarize features of collaborative tasks that promote productive interaction and present group awareness tools (GATs) and collaboration scripts as two approaches for supporting students to engage in productive interaction during collaborative learning.

**Collaborative learning**

Collaborative learning can be defined as “a situation in which two or more people learn or attempt to learn something together” (Dillenbourg, 1999, p. 1). This broad definition takes into account various learning settings, which have in common that learners are not simply presented with information but actively construct knowledge by interacting with other learners. Collaborative learning can, for example, take place in pairs (dyads) of students (e.g. in reciprocal teaching, Rosenshine and Meister, 1994), in small groups of around four learners (e.g. in a jigsaw puzzle, Aronson, 2002) or with the whole course (e.g. using a wiki-writing approach, Larusson and Alterman, 2009).

Several meta-analyses showed that collaborative learning promotes learning (Hattie, 2009; Pai et al., 2015) and that dedicated computer support can additionally enhance it (Chen et al., 2018). In collaborative learning settings, learning results from interaction between the learners (Chi and Wylie, 2014 for an overview). Although different theoretical perspectives posit different interaction processes as central to learning (Slavin, 1996), all collaborative learning settings encourage learners to engage in interaction that leads to constructing new knowledge together instead of simply rehearsing previously learned content (Stahl et al., 2006). King (2007) provides a list of activities during collaborative learning that can promote learning if they occur. Activities such as asking thought-provoking questions require learners to verbalize their thoughts (thinking aloud). This allows the other group members to observe reasoning processes and internalize them by imitation (modeling of cognition). Thinking aloud can also spark new discussions when group members pick up ideas and debate them. During argumentation, learners need to explain and clarify their ideas by using examples to illustrate concepts (elaboration) and by making connections between concepts explicit (organization). If learners fail to make ideas understandable to others, they can identify gaps in their knowledge. This in turn can spark collaborative learning processes that are directed at filling these gaps. During argumentation, learners also need to reconcile cognitive discrepancies that arise from opposing perspectives on the topic of the discussion.

Collaborative learning encompasses more than these socio-cognitive activities. It is equally important to take into account learners’ emotions (Järvenoja and Järvelä, 2009) as well as their motivation to share their knowledge with the group (Matschke et al., 2014). A group also needs to monitor these aspects throughout the collaboration and regulate in case of unproductive interaction or states (Hadwin et al., 2011).
Designing for effective collaboration
Assigning learners to a group does not automatically lead to productive interaction (Kreijns et al., 2003). To provide the opportunity for this interaction to occur, teachers can use designated instructional design to develop tasks that require learners to interact and thus construct knowledge together.

Setting the learning goal(s)
When designing a collaborative learning activity, teachers have to determine what students are expected to learn from the activity. Rummel (2018) refers to this as goal (e.g. learning about a particular topic or acquiring collaboration skills). Related to the goal of a collaborative activity, but not identical to it, is the type of interaction that is targeted by support measures to achieve this goal (target). For instance, the goal of a learning activity can be acquiring new content knowledge. To achieve this goal, a teacher can engage students in reciprocal teaching (Rosenshine and Meister, 1994), where students take turns explaining something to their partner. Thus, the target of the instructional support is the specific type of interaction between the learners. Though only few instructional frameworks distinguish between these dimensions (Holstein et al., 2020), considering these aspects separately allows for more precise instructional design.

Finding the right level of task complexity and creating positive interdependence
A collaborative task should be complex enough and require students to co-construct knowledge to solve it. If a collaborative task could similarly be solved by a single student, the additional demands that stem from collaborating (e.g. having to coordinate and integrate contributions of groups members) will outweigh the benefits of collaborative knowledge construction (Kirschner et al., 2011). If the instruction to a collaborative learning activity simply asks students to “solve the task as a group”, students tend to use a divide-and-conquer approach which relies on distributing subtasks and solving these individually. This approach will obviously leave little room for collaborative knowledge construction. To design collaborative tasks that require students to interact, Dillenbourg and Jermann (2007) suggest to “split where interaction should happen” (SWISH). This design rationale advises designing tasks in a way that they “naturally” require interaction between learners. A “split” can, for example, mean dividing task materials such as research evidence from different fields between group members (jigsaw-puzzle, Aronson, 2002; Deiglmayr and Schalk, 2015). If the students are asked to use this evidence to arrive at a shared decision they have to pool the information held by each group member, elaborate on this unshared information, discuss alternative solutions and agree on a joint decision (jigsaw schema, Dillenbourg and Jermann, 2007).

Other ways to incorporate “splits” into collaborative tasks include distributing roles with opposing perspectives on the topic (conflict schema, Dillenbourg and Jermann, 2007) or distributing complementary cognitive and metacognitive tasks (e.g. one learner provides an explanation whereas the other requests examples; reciprocal schema, Dillenbourg and Jermann, 2007).

Using this design rationale creates a positive interdependence between learners (Johnson and Johnson, 2009) which is a central prerequisite for effective collaborative learning. Positive interdependence describes a situation where an individual can only reach their goal (e.g. a good grade) if the other group members also reach their goals (Johnson and Johnson, 2009). In the example mentioned above, one individual group member alone is unable to solve a task because it is too complex and requires integrating knowledge from multiple domains. Positive interdependence creates individual responsibility, that is, each group
member feels obliged to contribute their fair share to the work and facilitate the work of the group members (e.g. by offering explanations or giving motivational support). Additional positive interdependence can be created by allowing students to form the groups on their own, invent a group name and logo, as well as by coupling the individual reward (e.g. grade points) to the quality of the final group product (Johnson and Johnson, 2009).

Forming groups of students

Teachers further need to plan which students form a group. Heterogeneous groups have been found to be conducive to learning (Tsovaltzi et al., 2019; Dillenbourg et al., 1995). To explain these effects it is, however, important to consider how characteristics of the group members affect the interaction among learners (Tsovaltzi et al., 2019). For example, assigning learners with different majors to a group can “SWISH” and support a jigsaw-type interaction. However, forming homogeneous groups can also be beneficial. For instance, Wichmann et al. (2016) found that grouping less active students with other less active students increased their participation. Therefore, when assigning students to groups, it is worth considering how student characteristics might influence interaction processes.

Regarding group size, forming small groups (e.g. four students) is advised because increasing group size reduces the visibility of individual group members and their contributions. This increases the risk that individual group members invest less effort into the collaboration (Johnson and Johnson, 2009).

Technological affordances for collaboration

The technologies that are available to the groups in the online environment also affect the interaction. Jeong and Hmelo-Silver (2016) describe seven affordances of computer-supported learning environments that facilitate different aspects of collaboration. The first affordance is access to communication channels. Each communication medium is associated with specific constraints and thus determines the extent to which learners can give each other immediate feedback, how many social cues (e.g. facial expressions) are conveyed (media richness, Rice, 1993) and how easily learners can develop a shared understanding (common ground, Baker et al., 1999). For instance, explaining something via e-mail requires more effort than giving a verbal explanation during a video conference (Clark and Brennan, 1991). On the other hand, e-mailing allows to review a message in the future and forces learners to clearly describe their ideas, thus learners can more easily notice gaps in their explanation.

Supporting students in monitoring and promoting productive interaction

Though instructional design sets the stage for interaction that promotes learning, research suggests that groups require additional support to engage in productive interaction (Rummel and Spada, 2005). Therefore, we present two approaches to supporting collaborative learning in online settings: GATs facilitate monitoring and regulating the collaboration implicitly by providing groups with visual feedback and collaboration scripts explicitly guide learners how to engage in productive interaction (Bodemer, 2011).

Implicit support: group awareness tools

Successful collaboration requires the students of a group to monitor and regulate their group processes (Hadwin et al., 2011). To this end, learners observe (monitor) the collaboration and compare the current state with a desired state (e.g. if all group members actively contribute to the task). If the current state deviates too far from the desired state, the learners
in a group might want to adjust (regulate) the interaction to be more productive again (Soller et al., 2005). These processes are demanding, especially in asynchronous computer-mediated settings, because these settings provide only few cues for students to assess if regulation is needed (e.g. how much each group member has contributed to the task). GATs facilitate monitoring and regulation by collecting collaboration data and visualizing it for the group (Janssen and Bodemer, 2013). For example, a GAT can use a bar graph to visualize the number of words contributed by each group member or the results of a quiz to indicate knowledge gaps. The GAT functions as an anchor for interaction that aims at assessing the current state of the collaboration and deciding how to regulate the collaboration.

To design a GAT, teachers need to decide which aspect of the collaboration they want their students to pay particular attention to. Also it has to be determined how this aspect can be measured (e.g. participation as “word count,” or knowledge on the current topic as “results of an online-quiz”) and how the current state should be visualized (e.g. a bar graph).

For instance, a GAT could mirror if group members perceive the current interaction as effective. To collect this information, students answer an online questionnaire on how satisfied they are with the group’s coordination, the quality of the contributions and the conflict management. The teacher then computes the mean scores for each group and visualizes the results using a pre-programmed spreadsheet. These results are then sent to the respective groups via e-mail or displayed in the learning management system. Each group can then use the visualization to discuss if regulation is needed and adapt the interaction accordingly. Further advice for implementing a GAT is offered by Wise (2014).

Altogether, GATs support collaboration implicitly by providing feedback on the collaboration. As GATs provide groups with only feedback, they leave groups agency if and how the collaboration is regulated. But at the same time, groups need to take agency, be proficient enough to interpret the visualizations and enact appropriate regulation strategies. Research suggests that some groups might lack these skills and could benefit from additional guidance (Dehler et al., 2009). For example, color-coding (un)desired states can facilitate interpreting the GAT (metacognitive tools, Soller et al., 2005). Further guidance could include promoting deliberate processing of the GAT and subsequent regulation by requiring students to explicitly discuss the data in the GAT and to agree on regulatory actions (Phielix et al., 2011).

**Explicit support: collaboration scripts**

Unlike GATs, collaboration scripts immediately guide the interaction processes in a group (Vogel et al., 2017). Similar to a script for a theatre play, a collaboration script specifies sequences of activities (play), particular activities (scenes), specific ways how these activities can be enacted (scriptlets) and roles that the learners take (Fischer et al., 2013). By following the script, learners practice effective interaction (e.g. argumentation) and become increasingly proficient in this skill.

Educators can develop their own scripts or use existing scripts such as the jigsaw puzzle (Aronson, 2002), reciprocal teaching (Rosenshine and Meister, 1994) or ArgueGraph (Dillenbourg and Jermann, 2007). To develop a collaboration script, educators have to break down the learning activity and specify which interaction processes they want to promote (target, Rummel, 2018). Next, teachers need to determine phases of the activity and assess if students need additional guidance how to enact certain activities (e.g. sentence openers).

For example, a discussion script can pair students with different opinions (roles) on a topic and let them discuss their positions (ArgueGraph, Dillenbourg and Jermann, 2007). To assess students’ initial position and to form the pairs, a teacher uses a questionnaire where students rate statements on the topic. Based on the results, the teacher forms pairs of
students who are tasked to discuss questions (*play*). During discussion, students have to exchange arguments and to agree on a joint answer that summarizes their final view on the topic at hand (*scene*). If learners have little experience with argumentation, the script can additionally provide sentence openers that guide the learners how to phrase certain types of arguments (*scriptlet*), such as “You claim that [...], however, [...]” (Noroozi *et al.*, 2013).

A straightforward way to present a script is in a written form. Learning management systems such as Moodle also allow educators to directly implement a script by using the conditional activity and activity completion features. These features let teachers display elements such as instructions only under specific circumstances. This allows to automatically sequence activities and additional hints or provides support only to those groups that struggle (adaptive scripts, Deiglmayr and Spada, 2010).

**Final considerations**

Online education can benefit from collaborative learning, as this teaching strategy not only fosters social presence but also promotes learning of new content knowledge and of collaboration skills (Radkowitsch *et al.*, 2020). Educators can leverage these benefits by carefully designing learning activities and providing learners with additional support that helps them engage in productive interaction. It is important to note that these instructional means are no guarantee that productive interaction between learners occurs. However, they greatly increase the probability that students will engage in beneficial interaction, which ultimately promotes learning (Strijbos *et al.*, 2004). Besides fostering productive interaction between learners, educators should also be aware of typical challenges during collaboration that reduce the effectiveness of interaction and cause frustration among students (Strauß *et al.*, 2018; Hadwin *et al.*, 2018, for overviews). To design for productive interaction and mitigate typical risks, we described steps for designing collaborative tasks and support. However, the design process comprises a number of specific design choices which we were not able to cover exhaustively in this brief paper. A more detailed account of design dimensions for collaboration support can be found in the framework presented by Rummel (2018). Also, we presented GATs and collaboration scripts as two broad yet separate classes of collaboration support. These approaches to support collaboration are complementary and can potentially be combined (Strauß, 2019). GATs provide groups with information on their collaboration (foundation, Rummel, 2018) but do not specify if and how groups should adjust their collaboration so that it becomes productive again. Collaboration scripts can provide additional scaffolding for these processes (directivity, Rummel, 2018). For example, groups that struggle to interpret the visualization in a GAT can receive explicit guidance that helps them to make sense of the GAT and receive hints how they can regulate the collaboration.

Our article focused on how teachers can prepare for implementing collaborative learning activities in their courses. However, the teacher also plays a crucial role during collaborative learning (Kaendler *et al.*, 2015). Specifically, a teacher monitors the processes and can step in to stimulate new interaction. As described, monitoring is a demanding task – also for teachers. To help teachers keep an overview on the groups and decide which groups might need assistance, research has explored teacher orchestration tools (van Leeuwen and Rummel, 2019, for a review).

Finally, we want to acknowledge that an online course should not exclusively consist of collaborative learning activities. Consequently, teachers have to orchestrate collaborative activities with other (individual) learning activities (Surma and Kirschner, 2020, for an overview). A useful concept when integrating different learning activities is the “didactic envelope” (Dillenbourg and Jermann, 2007). This refers to both, activities that prepare
students for a collaborative task and activities that build upon the results of a collaborative activity. For instance, each learner reads a different text individually to acquire expert knowledge and collaborate in an online jigsaw group for one week. Afterwards, groups present their solutions in a synchronous session and the teacher contrasts the solutions in a plenary session.

To conclude, despite the potential to enhance particularly online learning, collaborative learning is demanding for learners and teachers alike. Yet, we hope that our article inspires teachers to implement collaborative learning into their course, as online students can greatly benefit from well-designed collaborative learning activities.

References


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