Exploring Teacher Presence During Social Regulation of Learning in Science Classrooms

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Abstract: We studied the extent to which teacher presence relates to social regulation of learning in a collaborative model-based learning task in two high school physics classrooms. We found that groups engaged in argumentation discourse without the teacher actively monitored their understanding and used adaptive regulation strategies. The groups in which the teacher was present during the discussion relied on the teacher for regulation of learning. We discuss the implications for science teachers and teacher educators.

Introduction

In this qualitative study, we aimed to illuminate how teacher presence relates to high school students' social regulation of learning during collaborative work in a model-based learning task in physics. Science educators have increasingly relied on collaborative learning in small groups as a preferred way to foster to foster students' argumentation and subsequent learning, because it has been shown to promote both individual and group knowledge gains (Scardamalia & Bereiter, 2014). Students' interpretations of the work of others, supported by the use of evidence, such as interpretations of models in science, are one example of group knowledge creation (Scardamalia & Bereiter, 2014). Thus, science teachers have strived to engage their students in collaborative model-based reasoning. However, researchers have found that, without instruction and support, students in groups will struggle to work together successfully and take control of their learning. Therefore, teachers need to be able to facilitate students' knowledge building and engagement in productive argumentation discourse by orchestrating and scaffolding effective collaborative activities (Hmelo-Silver & Barrows, 2008). Additionally, researchers have shown that successful collaborative learning necessitates that group members have good regulative skills (i.e., planning, monitoring, controlling and evaluating their learning). In collaborative settings, group regulation skills and enactment are defined as social regulation of learning (Hadwin, Järvelä, & Miller, 2018).

Current theories and models of social regulation of learning have emphasized that regulation is socially situated and combines individual and social processes (Hadwin et al., 2018). Thus far, researchers have focused on emergence of regulation in small collaborative groups, as well as the challenges groups experience and their subsequent adaptive responses (Panadero & Järvelä, 2015). In some situations, teachers are also a part of the collaborative group, but the ways in which such groups' social regulation of learning may vary due to the teachers' presence remain under researched. Thus, we strived to contribute to the body of knowledge on social regulation of learning through a naturalistic study of two high school physics teachers and their students. Our study was framed by the following research question: *How does presence or absence of the teacher during a collaborative model-based learning task in high school physics relate to groups' social regulation of learning?*

Methods

Our study was a part of a larger, federally funded project carried out in a large, public high school located in a small city in the northeastern United States. Participants were two physics teachers and their students. The school's student population was predominantly Caucasian (91%) with a large proportion of students who qualified for the free or reduced-price lunch program (57%). About half of the students in the school were female (49%).

For this particular study, we focused on the first learning task in a yearlong curriculum and used video data of the small groups as our primary data source. We purposefully selected four teacher-formed, heterogeneous groups of students in two physics classrooms and investigated students' social regulation of learning. Both teachers were male. For the two groups in the first classroom (i.e., Group A, $n = 6$, and Group B, $n = 5$) the teacher was present at the group's table for the whole discussion. The two groups in another classroom (i.e., Group C, $n = 3$, and Group D, $n = 3$) carried out the discussion independently while the teacher circulated the classroom, stopping by each group intermittently. The lesson focused on why a reusable hotpack released heat after clicking the activation disk. To answer this essential question, teachers gave students readings, guiding questions, an argument scaffold, and a hotpack. Students then engaged in small group argumentation discourse to evaluate a scientific model of this phenomenon and determine the merit of the model claims, using reasons and evidence.

For our data analysis, we employed video analysis according to the guidelines for research in the learning sciences (Derry et al., 2010). Researchers separately watched videos of each of the four groups and then met to discuss them. We wrote time-indexed notes about each group's session and partially transcribed interesting episodes. We discussed our observations of the students' social regulation (i.e., planning, monitoring, controlling, and reflecting) as well as how it differed due to the teacher's presence, until we reached agreement on themes.

Results and discussion

During the four group discussions, we found that the quality of discussion and social regulation differed between groups with and without the teacher. In the two groups with the teacher present (i.e., Groups A and B), the teacher prompted the students to consider each of the three claims separately, and to use reasons and evidence to support their views until they reached consensus on each claim. During these discussions, the students responded mostly to the teacher prompts and questions, with very limited interaction occurring between students. Thus, the enacted discursive engagement aligned with a version of the traditional initiation-response-evaluation pattern. All of the regulation was external to the group (i.e., initiated by the teacher), with limited opportunities for students to regulate on their own. Students in these two groups did not experience joint construction of task understanding and had limited engagement in monitoring of their content understanding or evaluation of the task completion.

Groups C and D had quite different discussions. In these groups, the teacher visited the groups intermittently. In both groups, he visited at the beginning to make sure they understood the task, during the middle of the discussion to make sure they were on the right track, and at the end to determine if they had finished the task. The rest of the unsupervised time, the students engaged in conversations about task understanding, monitored their understanding of the content using phrases such as "I don't understand", sought help from the teacher (e.g., "I need help") when he came by to check on them, evaluated their task completion, and engaged in argumentation discourse as they determined the merit of the three claims. These groups also, however, engaged in more off-task behavior than the groups with the teacher consistently present.

Our findings revealed that for our four groups, when teachers were more present, there were fewer opportunities for students to regulate their own learning, but students were generally more on task than students in the groups with less teacher presence. Importantly, we found that in groups in which the teacher was less present, students more actively monitored their understanding and used adaptive regulation strategies (e.g., seeking help), as opposed to their counterparts in groups with more teacher presence. We believe that in the absence of the teacher the control shifted to the group members as the lesson required the students to engage in regulation. Our findings have implications for teachers interested in fostering social regulation in small group discussions. Teachers should teach, scaffold, and support students' interpretative authority through direct engagement as well as intentionally designed lessons. Additionally, these findings are relevant for teacher educators working to improve teachers' use of effective science teaching and discursive practices.

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