Moderators of Group Productive Disciplinary Engagement

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Abstract Group engagement in STEM disciplinary tasks is a multidimensional phenomenon. We developed a rubric that allows us to measure these different engagement dimensions, the interrelations among them, and the role of moderators in those interrelations. We provide a brief qualitative exemplar demonstrating this multifaceted conceptualization of engagement while exploring how the interrelationships amongst moderators impact group disciplinary engagement and account for the qualitative differences among our quantitative ratings.

Introduction

This research builds from Engle and Conant's (2002) conceptualization of *productive disciplinary engagement* (PDE) as making collective intellectual progress related to core ideas and scientific and mathematics practices during authentic tasks. In a 3-year project, we developed a framework to describe group productive disciplinary engagement (GDE) (Rogat et al., 2020). The framework and methods developed in the project capture the complexity of group engagement over time, afford exploration of the moderators that emerge toward explaining engagement quality and trajectories. This poster presents illustrative examples of the findings emerging from this research including the interrelations among dimensions of group engagement, as well as the moderators of group engagement contextualized in the enactment of STEM project-based curriculum.

We apply a situative perspective to understand collaborative group engagement as negotiated and constructed in activity systems (Danish & Gresalfi, 2018) serving as instructional opportunities that support or constrain engagement. These activity systems are inclusive of curricula materials, teacher scaffolds, tasks, and interactions among learners (Greeno, 2006). We extend prior conceptualizations of individual student engagement to: a) broaden the analytic focus to encompass collaborative groups' shared engagement; b) characterize engagement as multifaceted, and c) describe engagement as interrelated. We conceptualize and operationalize engagement as social and representative of collective group norms (i.e., those that are shared and endorsed by the whole or the group majority). To accomplish this, we characterize the norm of students' observable behaviors, discourse content, interactions among groupmates, and nonverbal behaviors.

Method

GDE is contextualized in collaborative tasks involving modeling, design, and argumentation in middle school math, science, and engineering. We draw on a rich corpus of video data collected in three projects where group work was central to unit goals and what groups came to understand. In this poster, we draw on a subcorpus of video from one of those projects, the *Systems and Cycles* project, which aims to promote learning about complex systems through modeling ecosystems (Hmelo-Silver, et al., 2017).

We employ a multidimensional conceptualization of engagement, which enables observation of the individual dimensions of engagement that together constitute GDE and affords the examination of the interrelations and patterns among engagement dimensions over time. We specify five dimensions of group engagement: *Behavioral engagement (BE)* characterizes the group's joint on-task engagement. *Socioemotional engagement (SE)* involves the group's positive or negative climate, characterized by the respectful, inclusive, and cohesive nature of interactions. *Collaborative engagement (CE)* characterizes the coordination and responsiveness in the group's contributions and when co-constructing knowledge. *Metacognitive engagement (ME)* is group planning and monitoring (i.e., joint regulation) focused on understanding and progress targeted to the task, content, and/or disciplinary practices. D*isciplinary engagement (DE)* refers to contributions which form connections that integrate conceptual and disciplinary competencies, with these connections supported by rationale. Each dimension was coded on three quality levels - low (1), moderate (2), and high (3) - apart from DE which had ratings of (1) low, (2) moderately low, (3) emerging, and (4) high.

The subcorpus of video included 148 2.5-minute intervals across four groups. Multiple raters assigned rubric quality ratings for the five engagement dimensions and developed case narratives from recorded intervals
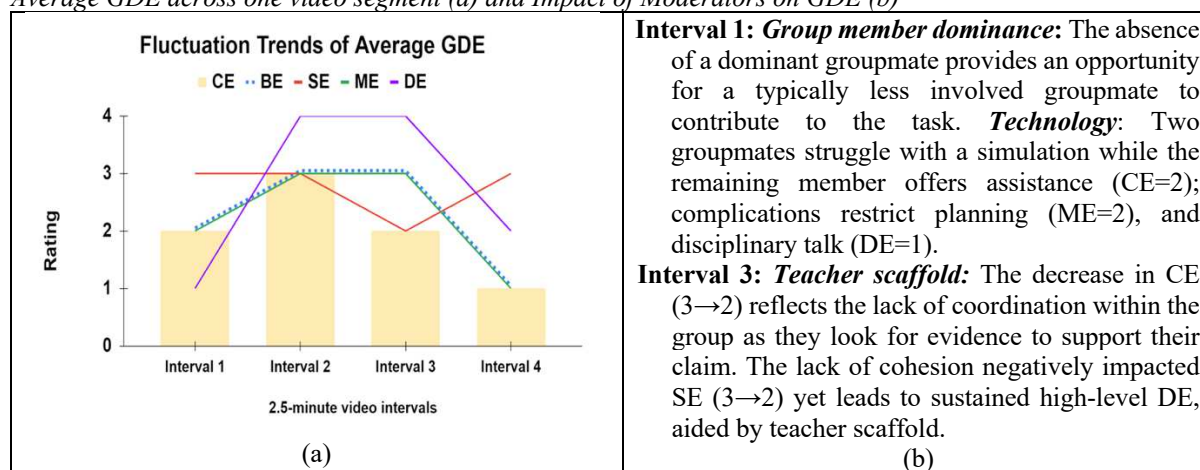
aimed at describing the interrelations of GDE. These narratives were reviewed to identify and characterize the role of the moderators of engagement. We present an example of a group using simulations during the final lessons of the unit to find the relationship between environmental factors and CO2 emissions. In this segment, we examine the change in CE work practices when one member leaves the group and the implications for subsequent engagement.

Findings & Conclusions

Our rubric captures the complexity of engagement across the five dimensions of GDE while incorporating moderators such as social dynamics (e.g., group member dominance), technology, and teacher scaffolds. For example, analysis of one 10-minute segment (four 2.5-minute intervals) from an Aquatic Ecosystem unit showcases engagement characterized by an increase in BE, CE, ME, and DE followed by later decreases (see Figure 1a). SE was sustained at a high level with a temporary drop in interval 3. Our narrative analyses revealed that the group's engagement was moderated by a group member's dominance, the technology used in the task, and teacher scaffolds (see Figure 1b).

Figure 1.
Average GDE across one video segment (a) and Impact of Moderators on GDE (b)

(a)	(b)
	Interval 1: *Group member dominance*: The absence of a dominant groupmate provides an opportunity for a typically less involved groupmate to contribute to the task. *Technology*: Two groupmates struggle with a simulation while the remaining member offers assistance (CE=2); complications restrict planning (ME=2), and disciplinary talk (DE=1). **Interval 3:** *Teacher scaffold:* The decrease in CE (3→2) reflects the lack of coordination within the group as they look for evidence to support their claim. The lack of cohesion negatively impacted SE (3→2) yet leads to sustained high-level DE, aided by teacher scaffold.

This project provides evidence that the GDE rubric can capture the ways that both students and the contextual features of learning environments inform groups' negotiation of shared engagement practices. This approach enables future research, including an examination of how moderators of GDE support disciplinary progress.

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