

Insights from a multi-method assessment of collaborative engagement in student groups

Abstract (max. 150 words)

We investigate the Quality of Collaborative Group Engagement (QCGE) in Computer-Supported Collaborative Learning (CSCL), employing a multimethod approach. Analyzing 38 triad groups, the study combines advanced methods such as video analysis (verbal and nonverbal behavior) self-assessment, trained observer ratings, and natural language processing (NLP). The results produced key insights into QCGE. First, the observer ratings and self-assessments exhibited limited variance and considerable skewness in most QCGE dimensions, significantly limiting their usefulness. Second, nonverbal behaviors and linguistic markers extracted using NLP showed small to moderate correlations with QCGE ratings, suggesting opportunities for measuring QCGE in an automatized fashion. Our study emphasizes the importance of multimethod approaches for understanding QCGE and highlights a potential to refine these methodologies using artificial intelligence to increase the accuracy and reliability of QCGE assessment.

Extended abstract (max 750 words):

Introduction:

Computer-Supported Collaborative Learning (CSCL) represents a field where the understanding of complex learning dynamics can benefit significantly from multimethod research approaches. As CSCL environments integrate various interaction modalities, they offer rich data streams that can be leveraged to overcome traditional, single-method research paradigms (Wise & Schwarz, 2017). Past work has individually considered self-assessments (Jeong & Hmlo-Silver, 2010), video analysis (Zahn et al., 2021), and observational approaches (Sinha et al., 2015). We propose that these methods, which each contribute a distinct perspective, must be integrated into a multimethod approach to provide a more comprehensive picture of the collaborative learning process in CSCL (Hmlo-Silver & Jeong, 2021). In our study, we take a multimethod approach (Paneth et al. 2023) to predict the *quality of collaborative group engagement* (QCGE; Sinha et al., 2015) in CSCL groups using indicators based on different sources of data. QCGE is a standard observational assessment consisting of four dimensions: Behavioral Engagement (BE), Social Engagement (SE), Cognitive Engagement (CE), and Conceptual-to-Consequential Engagement (CC). We predict QCGE using indicators based on self-assessment, video analysis of nonverbal behavioral, and natural processing of spoken communication. This analysis permits us to evaluate the contributions of different methodological approaches for the prediction of group

engagement in CACL settings.

To generate the empirical basis, we conducted a study involving 38 triad groups (N = 114), each completing a design task within a realistic learning setting in higher education. The design task asked groups to solve the complex problem of designing a floor-plan for a co-working office within 70 minutes. The behavior of the triads was video recorded for the total duration of the task. Based on these recordings, trained human coders rated QCGE at one-minute intervals using the rating scheme of Sinha et al. (2015) to establish the criterion of our analysis. To generate predictors of QCGE, we used three different approaches. First, trained human coders rated the video recordings to extract several indicators of non-verbal behavior. Second, we used natural language processing to extract several indicators, such as the uniformity of participation or communication sentiment based on a manual transcription of the recordings. Finally, we asked participants to self-assess QCGE based on a questionnaire that we developed for this purpose.

Findings:

Several noteworthy results emerged. First, the ratings of QCGE, in particular for dimensions SE and BE, were low in variance and exhibited significant skewness, limiting its usefulness of a criterion in predictive analyses. Second, we observed small but significant correlations between observed nonverbal behaviors and dimensions of engagement. Specifically, head nodding was significantly related to SE, laughing to BE; gesturing to CE; and eye contact to CC. Third, the indicators extracted using NLP similarly showed small correlations with QCGE. In particular, the uniformity of participation in the triad was correlated with SE, the use of personal pronouns with CE, and the amount of communication with CC. Fourth, the self-assessment showed overall high reports of QCGE and therefore also similar limitations due to excessive skewness in most dimensions, especially in SE. It is important to note that the self-assessment is based on an overall estimate of QCGE for the whole task, whereas the video and NLP methods can predict the development of engagement over time.

Discussion:

The multi-method approach applied in this study revealed several key insights regarding QCGE. The observational rating scheme, which is laborious and time-consuming to implement, showed low granularity, limiting its potential for revealing nuanced differences in group engagement and acting as a benchmark for method development. Nonverbal behavior was established as a useful predictor of QCGE, but is inherently limited to the nonverbal layer of observation, as it does not consider verbal communication. The self-assessment questionnaire, although valuable for

economically capturing subjective experiences, does not capture the temporal development of engagement and could potentially be prone to social desirability and other influences common in self-report assessments. The innovative use of NLP presents a promising, albeit currently limited, frontier in objectively assessing QCGE based on the verbal layer of observation.

Overall, our study provides insights into the application of the multimethod approach to assess collaborative engagement. The small to moderate empirical relationships between rated, linguistic, and nonverbal indicators of QCGE suggest they likely offer unique perspectives that could be combined to provide a holistic account of QCGE. Currently, these indicators, especially those based on human ratings of engagement and nonverbal behavior, are expensive to generate. However, with advancements in artificial intelligence, we anticipate accurate and nuanced automated assessments of QCGE to become feasible, promising to advance both research and practice.

References:

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