The automated assessment of collaborative learning is a long-standing dream for educational research (Strijbos, 2011; Gress et al., 2010). A more pressing and achievable objective for learning analytics has been to provide teachers with insights into student interactions (Strijbos, 2011; Stahl, Koschmann & Suthers, 2006) so that teachers can offer personalized feedback to them. In order to be most effective for teachers, insight into complex computer supported collaborative learning environments needs to be accessible without performing time consuming in-depth analyses or observing every collaborative activity (Stahl, 2013). This need is especially felt in cases of technology mediated small group learning. Small group learning environments, such as Virtual Math Teams (VMT), do not yet have useful instrumentation to identify students and groups who model effective learning, who is struggling, or who experience difficulty using the environment. When the design of a socio-technical environment divides students into separate learning spaces for small group interaction, teachers face challenges facilitating or directing activity; with 3 students per group, 30 students doing an hour of activity translates into ten hours of student activities for teachers to analyze.

Prior assessment research examining VMT and other small group learning environments has employed computationally focused (e.g. Mirriahi et al., 2013; Koulocheri & Xenos, 2013) or labor intensive methods (Kapur, Voiklis & Kinzer, 2008; Stahl, 2013) for the analysis of student interactions. Time-intensive methodologies are helpful to researchers, but impossible from a practical perspective as teachers need to be able to engage in timely interventions. On the other hand, automated counting of data generated by these learning environments are oftentimes only “blunt instruments”; the analysis cannot be operationalized toward the human experiences in a technology mediated learning environment, as automation is grounded in mathematical theory rather than more nuanced theories of human behavior. In order to facilitate learning, teachers
require a holistic view of student activity in the learning environment, specifically informed by theory.

One way to help teachers facilitate learning is through an analysis of student participation in collaborative activities (Gunnarsson & Alterman, 2012); knowledge of who is not participating can predict failure (Romero et al., 2013; Hrastinski, 2009; Morris, Finnegan & Sz-Shyan, 2005). These indicators, however, do not allow teachers to take account of the diversity of activities that students participate in or to discern the meaning of numbers beyond those at the lower boundary of participation. One proven path between the simplifications of raw numbers and the labor intensiveness of qualitative assessment is described as multi-vocality, where many different research approaches move to understand the nuance of interactions in a technologically mediated learning environment (Suthers et al., 2011). Xing et al. (2014, 2014, and 2016) argue for a systematic, focused use of computation for filtering of incidents that researchers and teachers can analyze in greater depth using more time-intensive methods.

In this study, we propose a theoretically-founded system of rapid and automated assessment that is able to provide teachers with accurate and robust insight into the quality of student participation and performance. This increase in awareness may not only alleviate the burden for teachers in the process of assessment, but it may also assist teachers in advising students participating in group activities without requiring teachers to be actually present for all group activities. We demonstrate how such an assessment method is used in a synchronous CSCL environment (Virtual Math Teams with Geogebra —VMTwG), in which students work collaboratively in small groups to solve geometry problems. This paper is organized according to the two-step process by which our system of automated assessment has been constructed: First, activity theory (Engeström, 1999) is operationalized to inform our initial measure construction, allowing for the holistic description of student participation in the technology mediated group learning context. Second, these measures are utilized as part of an advanced genetic clustering analysis through which student participation is characterized, grouping similarly-performing students together in order that teachers may provide timely, efficient, and appropriate support. The effectiveness of this combined method is then tested against other algorithmic approaches. By presenting a sketch of an experimental method of assessment, we highlight the potential for a system of automated assessment to provide timely and semantically-interpretable information to teachers.
References


