INTERACTIONS IN BLENDED MATHEMATICAL LEARNING ENVIRONMENTS

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In examining interactions in an online environment, we utilize Moore's (1989) framework in which he outlined three types of interactions. In his work, he purports that to determine appropriate levels of interactions for effective learning, it is first important to be able to classify the types of interactions taking place in distance learning environments. He identified three interaction types: learner-content, learner-instructor, and learner-learner. We add to that, the work of Hillman et al. (1994), who added a fourth interaction, learner-interface.

We received a single video from each of 19 high school mathematics teachers with between six and 34 years of experience, representing seven different school districts. Three levels of coding were applied to the analysis of each video. First, the type of interaction was identified (learner-content, learner-instructor, learner-learner, learner-interface). Then the activity (level 2) within that interaction was coded. Finally, it was noted if technology was used during the activity. The researchers, who are the authors of this paper, met to view a video together, clarify the unit of analysis, and define each of the codes. A unit of analysis was considered a level 2 interaction type. When there was a change in the activity type, that was treated as a new unit to code. A video was coded together and then six videos were assigned to pairs of researchers to determine inter-rater reliability. Agreement on units of analysis was determined (87.1%) and agreement on codes on the units that were in common was calculated (86.7%). Once inter-rater reliability was established, the remainder of the videos were coded by one researcher.

In their online teaching, mathematics teachers are overwhelmingly utilizing learner-instructor interactions (75.97%), which are predominately expository. Of the learning-instructor interactions, 52.14% are expository and 29.91% are explanatory. Overall, 23.38% of the interactions were learners engaging with mathematics content. The majority of the learner-content interactions were students solving a problem (58.33% of learner-content interactions). Instances of problem-solving were observed across all learning types: hybrid classes (n=5), pre-recorded videos (n=10), and synchronous classes (n=6). In addition, we found evidence that teachers provided a few opportunities for their students to conjecture (n=8), confirm their answers (n=4), predict (n=2), and interpret their solutions (n=1). We found no learner-learner interactions of any type across the videos of our 19 participants.

The teachers were facilitating high school mathematics classes across different modalities of online teaching. Seven of the 19 videos were prerecorded (36%) included students in a hybrid setting or synchronous classroom. While there was a high percentage of learner-instructor interactions there were no learner-to-learner interactions observed across all videos. In hybrid and synchronous settings where learners were present with the instructor, typical interaction occurred between the teacher and the students. Could this be because of Covid-19 which requires social distancing among in-person students? Although, we noticed it also when students were remote. We may want to provide additional professional development to teachers, particularly

those teaching online, about ways they can engage students in conversations with each other to support mathematics learning.

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