# Pedagogically Informed Peer Teaching as a Mechanism for Systematically Maximizing Sociocultural Theories of Learning

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**Abstract:** Those who have witnessed peer-to-peer teaching are familiar with the typical ritual: "This is how you do it… do you get it?" followed by a head nod from the learner and they move on. In a world where student discourse is increasingly the vehicle for learning, it is critical that we give students tools to engage effectively with each other's thinking. Over the past year, I developed and tested a web-based application that successfully shifts how students think about peer-to-peer tutoring.

What I propose to share in an ICLS poster session is an activity system that acknowledges both the constructive nature of conceptual change and the critical importance of social interaction for learning. I call it *pedagogically informed peer teaching.* This activity system is contingent upon students' abilities to learn and enact strong pedagogy, which I have been training students to do using online simulations and tutorials over the past year. In my poster session, I would share the results of a pilot study completed last spring.

## Theorizing a more effective activity system for promoting learning

Socioculturalists assert that learning is a process of reciprocal transformation of self and environment, mediated by the tools, signs, and people around a learner. Critically, the nature of those tools and signs that mediate activity, along with the specific goals that focus activity, produce varying forms of practice and learning. For socioculturalists, all learning is culturally mediated and interactionally dependent. While socioculturalists recognize the central role of unique cultures and the reciprocal influence of culture on person and person on culture, they often abstain from offering a granular recipe for the process of learning. For Vygotsky (1986), learning occurs through interaction with a more knowledgeable other, through using tools and signs at the ready, and internalizing those ideas and processes that began as social and external.

Mere exposure to knowledgeable others is not enough to promote learning, though. As Vygotsky (1986) recognized, abstract thought necessitates verbalizing, a process whereby learners use language as a tool to connect complex ideas. Dialogic instruction, frequently performed by learner-centered teachers and expert tutors (Lepper, 2002), supports students in overcoming the type of disequilibrium students experience when encountering new and complex ideas that do not fit with their existing schema. Effective questioning makes visible to a learner how their current schema support and contradict the acquisition of new ways of thinking. Many expert teachers are currently being trained to use "talk moves" (Chapin et al., 2009) to elicit student thinking, probe it, and prompt reflection of it to support this process of overcoming disequilibrium, i.e. learning.

However, teachers in classrooms with 30 students cannot feasibly perform this type of questioning for each of their students who needs support. Fortunately, classrooms have many students with some degree of mastery over the content at hand. These students are the most underutilized instructional resources in classrooms, as they represent knowing others who can stretch the zones of proximal development for their peers. But we should not assume that students with mastery over content are good teachers. Studies have shown that when given a chance to teach, student tutors tend to do much more explaining than tutees (King, 1997), place minimal demand on tutees when questioning (Graesser et al., 1995), and rarely stimulate deep-level reasoning or do much to monitor the understanding of tutees (Graesser et al. 1995; Roscoe and Chi 2007).

If students learn through a process of overcoming disequilibrium, if overcoming disequilibrium is supported by effective questioning from a knowledgeable other, and if peers are the most readily available option for performing such questioning, we must discover ways of training students to serve in such a capacity for one another. This is the mission of this research project.

## Design principles for training pedagogically informed peer tutors

I designed the PeerTeach web application to train students to use evidence-based discourse tools (or "talk moves") to support the learning of their peers. As a design-based research project (Brown, 1992), this application is being developed through an iterative process of implementation, analysis, and adaptation. The goal is for PeerTeach to become a robust intervention that prepares students to be effective tutors for one another. At a high level, the system is predicated on the theory that students will become more effective real world tutors if they have the opportunity to 1) practice noticing and tagging high-leverage teaching moves during animated tutoring sessions and 2) practice using those same high-leverage teaching moves when

selecting the utterances of a virtual tutor in a game-like virtual tutoring experience. Sherin's (2005) noticing framework asserts that teachers (or in this case, tutors) must attend to important teaching moments, relate them to a useful pedagogical framework, and act based on pedagogically sound reasoning. Practicing such noticing should provide useful preparation for using better teaching moves. Practice using better teaching moves in simulated contexts provides necessary application. Seeing realistic responses from an automated virtual learner, in addition to symbolic representations of that virtual character's learning, reinforces belief and fluency around the new pedagogy, which I predict will translate to real world tutoring improvement.

Last year, data was collected to test the first aspect of the aforementioned theory of change: can minimal practice noticing high-leverage teaching moves in a mediated virtual space prepare students to observe with a pedagogically trained eye. Three groups of students were assessed before and after the PeerTeach noticing intervention on their abilities to tag "good" teaching moves in realtime; their scores were compared to those of math teachers who recently graduated from a prestigious, apprentice-based Masters and credentialing program.

The results in Figure 1 suggest students across all three groups improved in their ability to accurately identify high quality moves as good, but lag far behind adult teachers. Notably, students in both East Bay, California groups identified dramatically fewer high quality moves as good than did the students in Harlem, New York, who all had prior experience as both tutors and tutees. On average, the Harlem students identified 3.18 high quality moves as good in the post-assessment while the East Bay students identified, on average, only 1.23, suggesting the importance of tutoring experience for being able to analyze observed tutoring.
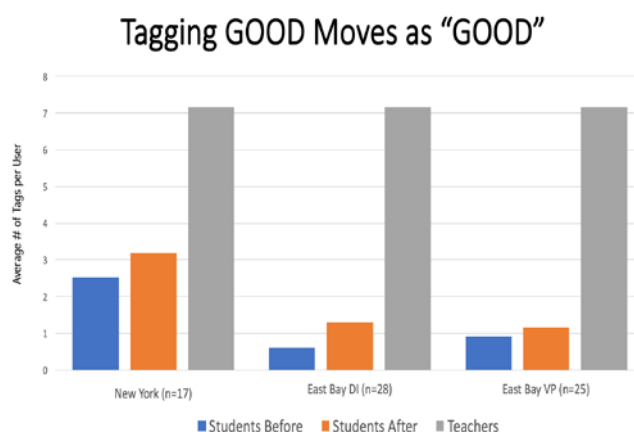


Figure 1. Tagging GOOD Moves.

This is the first in a series of studies aimed at identifying which aspects of the PeerTeach training platform are effective mechanisms for improving students' abilities to notice good teaching, choose effective teaching moves in virtual simulations, and eventually to tutor more effectively in real life. This poster session is intended as an exploration of this proposed activity system as an optimized model of learning and the student training it requires. The discussion will address both theoretical and practical points, grounded in the actual technology of PeerTeach and the data that emerged as students interacted with it.

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