

## Measuring Meaningful Learning and Mindset: Students' Expectations, Experiences, and Beliefs about Intelligence in the Undergraduate Chemistry Laboratory

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Every college student majoring in science or engineering takes multiple laboratory courses throughout their college education. While faculty cannot imagine teaching without laboratory, little evidence exists to claim that students actually engage in meaningful learning experiences in these courses. The typical role of the college laboratory in student learning has largely remained one of confirming principles presented in lecture rather than exploration and concept development. One challenge with measuring students' learning in the laboratory is that few measurement tools specific to the context of laboratory exist. This seminar will describe the development of two such assessment tools.

Meaningful learning requires that students choose to create connections between their prior knowledge and the material to be learned. For meaningful learning to occur, students must actively integrate not only their thinking and the doing of their laboratory work, but also their feelings and beliefs. We created the Meaningful Learning in the Laboratory Instrument (MLLI) to measure students' cognitive and affective expectations for conducting experiments in the undergraduate chemistry laboratory and to compare those expectations to their experiences. Students' beliefs about their intelligence, known as mindset, are context dependent and have not been previously characterized in a chemistry laboratory. Mindset reflects students' beliefs about the role of effort and ability as they contribute to success, especially in moments of confusion, uncertainty, or errors in the lab. We created the Intelligence Mindset in the Chemistry Laboratory (IMCL) instrument to measure students' mindset. This seminar will present data from multiple research projects using the MLLI and IMCL to investigate students' expectations for learning in the college chemistry laboratory, their experiences during these courses, and their beliefs about intelligence in the college chemistry laboratory. The implications for pedagogy and assessment within college laboratory courses will be discussed.