



Engineering and Science Education Seminar
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302 Rhodes

Mixed Methods Evidence of the Impact of Cooperative, Problem-based Laboratory Instruction on Metacognition Use and Chemistry Problem Solving Skills

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Abstract

The relevance of metacognition in learning and problem solving has been demonstrated; findings suggest it may even be more important for problem solving success than aptitude. The present study is an assessment of the impact of college chemistry cooperative problem-based laboratory instruction on students' development and self report of metacognition use. A mixed-methods sequential explanatory design was utilized. In the initial quantitative phase metacognition use was evaluated using a multi-method that combines a prospective self-report (MCAI) with a concurrent computer-based instrument capable of recording large numbers of performances (IMMEX). Quantitative findings indicate a significant increase in awareness of metacognition in the treatment group, as well as its outperforming of the control group in strategy efficiency and ability solving ill-structured problems. Three independent samples of students totaling over 1500 participants were investigated over a period of five semesters. Eleven student and 16 teaching assistant semi-structured interviews were used to collect qualitative data. Open-coding, analysis, and interpretation were conducted by a team of three researchers using a phenomenological approach. The outcome space sheds light into explaining the quantitative findings: The instruction created a learning environment in which the development and use of metacognitive skills was essential to completing the tasks assigned. Metacognitive prompting and an intense social interaction emerged as fundamental factors. This work exemplifies the multi-methods reliable assessment of metacognition use in chemistry and contributes sound and significant evidence addressing one of the most discussed and persistent questions in science education: what is the role of science laboratory instruction?

Presenter Biographical Sketch

Dr. Santiago Sandi-Ureña is currently a post-doctoral fellow conducting research in Dr. Melanie Cooper's research group at Clemson University. He obtained his B.S. in Chemistry from the University of Costa Rica and M.S. in Inorganic/Organometallic Chemistry and Ph.D. in Chemical Education from Clemson University. His developing research program revolves around the assessment and development of metacognition use in chemistry learning environments with a particular focus on the effect of research experiences.

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