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Efficacy of a combined lecture/laboratory model for student performance and engagement in introductory chemistry courses.

In this study, student success metrics using a combined lecture/laboratory "atoms-first" approach will be compared to traditional teaching models in which lecture and laboratory are separate courses with separate meeting times. This model was piloted earlier with the introductory course CHEM 108, Forensic Chemistry, which demonstrated increased student engagement due to daily rather than weekly laboratory activities. A curricular change was implemented in the CHEM 101 course, General Chemistry I, in the Fall of 2016. This model included new experimental and computational modules incorporated around the course material each week in addition to changing to an "atoms-first," structural model rather than a "stoichiometry-first" mathematical model over the first few chapters of the course.

Hands-on molecular modeling assignments have been included along with the curricular changes, which have allowed students to better visualize atomic and molecular structure. Evidence for the efficacy of these newly-developed assignments is shown in the results of exams primarily covering topics of structure and bonding, which are used as a tool of quantitative assessment between traditional lecture and combined lecture/laboratory models. In the traditional lecture model, the average exam score for this learning outcome was 65.8% (N = 45), whereas for the combined lecture/laboratory model, the average exam score is 71.2% (N = 64). Additional student learning outcomes results for both General Chemistry and Forensic Chemistry will be discussed, and changes in performance and engagement will be outlined.