

## Two-Stage Testing in Chemistry: How important is group composition?

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For the past two years, we have been experimenting with collaborative, two-stage testing in various chemistry courses. In this assessment format, students complete a test or problem set individually and then immediately thereafter complete a similar (but not necessarily identical) test in groups of 3 or 4. Overall test scores are then computed as weighted combinations of these two results. We have compared this examination style with more traditional evaluation methods and its effects on overall student performance. In particular, two-stage testing benefits from the practices of both *peer-to-peer learning* (P2PL) and *just-in-time teaching*, as students can learn the 'right' answer from a colleague during the examination itself.

In addition, this style of student assessment helps fulfill a key point in the accreditation guidelines set by the Canadian Society for Chemistry for our undergraduate programs: the ability of chemistry students to communicate effectively with their peers and engage in meaningful teamwork. Outside of the laboratory setting, this aspect can be too often neglected in chemistry lecture halls. Thus, incorporating this assessment method offers a unique opportunity for chemistry students to discuss and debate challenging problems with others, while both correcting misconceptions and reinforcing fundamental concepts in a formal setting.

The effectiveness of P2PL can rely heavily on the context and group dynamic: ideally, students should be engaged in a two-way reciprocal learning environment, where each participant contributes to (and benefits from) the discussion. However, due to the wide spectrum of both experience and expertise of students enrolled in chemistry courses, creating groups which satisfy this condition can be very challenging. Therefore, this past year we have explored one specific logistical aspect of two-stage testing: the choice of creating instructor-selected pre-assigned groups or allowing students to self-organize into their own groups. Each of these options carry advantages and disadvantages from the point of view of both instructor and student.

In this pilot project, our aim was to elucidate which method offers the greatest benefit to chemistry students. Students in a first-year general chemistry course took 2 two-stage midterms, one of each organizational style described above (pre-selected versus self-selected groups). In addition to directly comparing student performance data from these evaluations, we carried out an anonymous survey to gauge student opinions, and held a focus group to gather more detailed feedback. With these preliminary results, our goal is offer other science educators interested in implementing two-stage testing in their classrooms clearer 'best practices' guidelines, in particular for large courses.