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Facilitating student education and professional development through intensive in-classroom investigations using remotely operable microbeam instrumentation

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A key juncture in the education of undergraduates in geoscience programs is the transition from directed learner to independent investigator. While many U.S. geology programs are now offering experiences to help students develop research skills (i.e. "new wave" field courses on hydrology, volcanology, etc.), these typically don't include the kinds of open-ended data collection and interpretation experiences that students will encounter in their graduate studies or professional careers.

I received grant support from the U.S. National Science Foundation's Course, Curriculum and Laboratory Improvement program to build "real" research experiences into introductory and upper-level geology courses, making use of a remotely operable electron microprobe (EMP: a JEOL 8900R Superprobe) and scanning electron microscope (SEM: a JEOL JSM 5900LV with an EDAX EDS spectrometer) system to support real-time student data collection as an integral part of extended in-class research projects. The instrumentation (housed at the Florida Center for Analytical Electron Microscopy, at the Florida International University in Miami, FL) is fully operable remotely using UNIX terminal emulator software. I have built intensive student use of EMP and/or SEM into introductory and Junior-level geoscience courses at the University of South Florida, in Tampa, FL. Students in these courses have the option to follow their in-class research activities with a focused laboratory course (GLY 4947L) where they learn to use these instruments in greater depth and pursue independent investigations, to the point of presenting their work at a sectional Geological Society of America meeting, or like venue. To document changes related to these experiences, we have tracked gains in student learning and in their perceived mastery of geoscience content, as well as trends in student course selections, choices to complete post-course research activities, and post-graduation trajectories (i.e. seeking graduate training in geoscience fields).

In the three years of the project some fourteen students (two in year one, six each in years two and three; n = 65 for the three years of the upper-level course) have chosen to take the GLY 4947L course and pursue undergraduate research projects. Five undergraduates have so far presented their research results at professional meetings, and five projects are still ongoing. Three students so far have gone onto graduate studies in geology, and three others are now applying to graduate programs. Measures of student interest indicate the hands-on experiences with instrumentation are both empowering and appreciated, and measures of student learning, while difficult to validate in upper-level courses, seem to indicate greater retention of mineralogy/petrology content in particular, and no less content mastery overall than observed in our pre-intervention control group. These experiences increased student interest in science, though interestingly there was not a significant increase in interest in taking geoscience courses or pursuing geoscience degrees among students in the introductory class, even though several students from these classes followed their experiences with upper level geology courses and/or post-course research.