Abstract
Numerous reports have called for the reform of STEM education by adding more inquiry-based learning. Courses that emphasize the relevance of science to life situations and to scientific careers promote student interest and increase success. Transforming laboratories in lower-level STEM courses to inquiry-based learning is one way to achieve these results. These laboratories are often taught by graduate student teaching assistants (TAs) who lack pedagogical expertise to implement needed reform. At Western Michigan University with support from a HHMI undergraduate science education award, we created a professional development series for TAs to develop expertise in inquiry-based instruction.

Background & Significance
Ninety percent of the students who switched out of their science, technology, engineering or mathematics (STEM) major thought the teaching was poor (Seymour & Hewitt, 1997). Poor teaching and perceived lack of course relevance factor into high attrition rates in STEM (Singer, 2013). Complicating retention problems is lecture instruction that is often accompanied by “cookbook” laboratories taught by novice graduate student TAs (Austin, 2011).

Recommendations to reform STEM education include adding more active learning strategies and explicating the relevance of science to understanding real-life situations and scientific careers (AAAS, 2011). These solutions should be implemented in beginning STEM courses where a significant proportion of students report that poor teaching is the reason for switching out of STEM majors (Lederman, 2007).

Purpose & Outcomes
To equip TAs with skills to deliver inquiry-based instruction in the STEM labs and recitation sections they teach. Our outcomes center on the scientific method and Bloom’s taxonomy.

• Develop a teaching orientation for student-centered inquiry
• Develop pedagogical skills of scientific inquiry, experimental design, data analysis, and scientific arguments
• Build an increased sense of identity as teachers
• Increase self-efficacy for teaching a diverse audience
• Improve classroom management and engaging in active strategies and inquiry-driven science teaching
• Show commitment to continuous improvement of science teaching knowledge and abilities

Participants & Format
Summer Workshop
• 10 TAs representing chemistry, engineering, biological sciences, geosciences, and science education
• 2 faculty (one term, one tenured) from mathematics
• Nine-day intensive focused on inquiry-based techniques

Year-Long Series
• 6 TAs and 1 faculty member from original 12 who completed the summer workshop
• Twice monthly meetings with 2 faculty mentors (engineering, faculty development) that extended summer workshop topics

Assessments of Success
1. Pre (workshop day 1) and post (workshop day 9) survey using 0-5 Likert scale of TA perceptions on personal interest in using inquiry-based techniques and how various workshop activities will impact their students’ learning gains.

2. Post year-long series survey (using 0-5 Likert scale) of TA perceptions on personal interest in using inquiry-based techniques and how various series activities will impact their students’ learning gains.

Findings

Evidence of Effectiveness

Pre Workshop
• TAs were confident in their own knowledge of the scientific method, formulating hypotheses, designing experiments, analyzing data
• They were less confident about teaching those skills to students
• TAs showed neutrality regarding the effectiveness of inquiry-based techniques to improve their students’ learning performance

Post Workshop
TAs achieved significant gains in:
• Developing greater confidence and interest in implementing inquiry-based teaching to help students learn
• Communicating to a broad and diverse audience
• Using inquiry-based techniques and seeing the results of their efforts in the form of improved student learning

Post Year-Long Series
TAs continued to show:
• High confidence and interest in using inquiry-based teaching especially advanced skills (e.g., peer evaluation, flipped classroom)
• Recognition of how inquiry-based techniques enhance student learning performance
• Gains in personal growth as teachers, mentors, scientists, and as students themselves

A Lasting Impact
In 2019, the Office of Faculty Development (OFD) and HHMI grant successfully led the same summer workshop to 17 STEM TAs and/or faculty. Fifteen have continued on with the 19-20 year-long series.

In 2020-21 the STEM professional development workshop and series will become an official program in OFD yearly offerings.

References


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