TRESTLE PROJECT DESCRIPTION

Title: Collaborative Research: Deep Roots: Wide-Spread Implementation of Community-Driven Evidence-Based Pedagogy

I.   Objectives and Significance

Deep investments, by the NSF and other agencies, have resulted in a wealth of effective instructional strategies (National Research Council, 2012; Singer, Nielsen, & Schweingruber, 2012), but widespread implementation of these strategies remains elusive. This is due in large part to the lack of a practical model of educational transformation and faculty development that is sensitive to faculty needs, and can be adapted to different institutional contexts. To address this gap, we seek funding for a multi-university project to implement and study an adaptation of a successful model of STEM education reform, with the ultimate goal of improving student learning and educational outcomes. Our objective is to test a model of achieving widespread adoption of empirically-validated instructional methods, and promote changes in the culture of teaching and learning.

Our model is derived from research on institutional change and quality improvement, and builds on a course transformation initiative (the Science Education Initiative, or SEI) that has been successful at two of the partner institutions. ***The core of the approach involves supporting "embedded expertise" within departments, centered on course transformation, to catalyze changes in teaching practices and culture.*** In this model, STEM education "embedded experts" collaborate with department faculty to guide and support the implementation of discipline-based educational practices in STEM courses. The SEI was very resource-intensive, using many dedicated postdoctoral scholars as the primary change agents. In the current project we test an extension of this model that involves using a smaller infusion of resources, by including multiple types of change agents (postdoctoral fellows, faculty, and groups of faculty), and developing communities of scholars within and across departments, and across institutions. Such a model has already been pilot tested with preliminary evidence of success at the University of Kansas (KU). In the proposed project, a network of seven research universities, led by KU, will implement and evaluate adaptations of this model on their own campuses. The network itself serves two general functions: 1) to build a community for intellectual exchange and collaboration on evidence-based teaching as a key component of the intervention itself, and 2) to permit a test of whether the intervention model can be localized and implemented in different institutional cultures to propagate widespread STEM reform. We will use a combination of quantitative and case study evaluation methods to identify the various dimensions and conditions that signal initial readiness, successful approaches, and sustainable outcomes in participating institutions. The results can be used by other institutions seeking to make similar changes, in order to improve learning and educational outcomes for both STEM students and non-STEM students.

II. Broader Impacts

Despite significant investment in the identification of effective STEM pedagogy, it has had minimal impact on STEM teaching in higher education. Our findings will provide a wealth of new data to further our understanding of how to create scalable change on an institutional level, deepening the return on investment in STEM education reform. The resulting insights can be used by other institutions seeking to achieve similar changes to improve STEM education and undergraduate education more generally. Student success in STEM fields is an essential component of economic growth, so the primary target of this work has immediate application to a broad societal goal. Many of the redesigned courses also serve as the only exposure to science for many citizens, so a general increase in scientific literacy would also be valued. Improved undergraduate education will help to ensure a skilled and educated population with employable skills for the next century of jobs, a more diverse body of STEM professionals, and a citizenry that is informed, civically engaged, and more scientifically literate.

This work also builds on other national higher education efforts. The curriculum mapping of learning outcomes completed by departmental faculty is consonant with the activities based on the Degree Qualifications Profile (http://degreeprofile.org/). The focus on pedagogy, evidence-based teaching, and broader cultural change within departments and institutions aligns this project with the Association of American Universities STEM Initiative, which is based on the triad of pedagogy, scaffolding, and culture.