PROJECT SUMMARY

Overview:

We will create a national model for improving STEM higher education through a community-based web resource to help physics faculty transform their teaching by incorporating teaching methods and assessments based on research into classroom learning. Historically, higher education struggles to find ways to evaluate and improve instruction. We propose using a 'bottom-up' approach: instead of assessments imposed from accreditation agencies or higher education administration, in our model, discipline-based teachers/researchers develop, share, and aggregate assessment data.

Research-based assessment instruments have had a major impact on physics education reform. They provide universal and convincing measures of student understanding that instructors can use to assess and improve their teaching. The Force Concept Inventory (FCI) has been given to thousands of students worldwide; the use of similar instruments in nearly every subject area of physics is becoming increasingly widespread.

These instruments can transform teaching practice by informing instructors about their teaching efficacy so that they can improve it. At the same time, their widespread use can transform researchers' understanding of the impact of educational transformation by providing large quantities of data that compare teaching practices across a broad range of institutions and student populations. Our preliminary work suggests that physics faculty are eager to use their cognitive resources as scientists to explore big data and compare their students' assessment results to those of other students like their own.

Preliminary work suggests that while the use of these instruments is widespread, most instructors who use them do not know how to interpret the results or how to use them to improve their teaching. Further, because local results are known only to individual instructors, researchers cannot harness the large scale on which these instruments are already given.

We propose to turn the private practice of administering assessment instruments into a community practice of interpreting assessment results in the context of a large community of educators using similar practices in similar settings, comparing results, and using them to transform teaching practices both for individual faculty members and for departments as a whole. We will expand a prototype database developed as part of a current NSF grant (WIDER 1256352) into a community forum and data explorer that allow instructors and researchers to easily upload, discuss, and compare their data in an intuitive, interactive, and beautiful way. The data explorer will feature an intuitive user interface inviting exploration and discovery, interactive one-click analysis tools, a scalable database, and robust data security. This system will be incorporated into the PER User's Guide, an NSF-funded (NSDL 0840853, TUES 1245490) project that provides online resources for physics faculty about research-based teaching methods and assessments.

Intellectual Merit :

An elegantly designed and easily accessible user interface will enable faculty members to engage with their students' assessment data and the national dataset. Hundreds of faculty will better understand the effect of their teaching practices on students' learning and in turn develop further their use of evidence-based teaching methods to improve assessment results and student learning. The database of student assessments will be expanded to include results from smaller colleges and minority-serving institutions that traditionally have not been part of STEM education research. When fully operational, the database will include results from hundreds of colleges and universities.

Broader Impacts :

This data system will be based on prototypes being developed with current funding and will attract more users who will populate the system with an unprecedented amount of assessment data. This will open the doors for physics education researchers and faculty to answer questions about students' learning that were previously inaccessible. We expect that the availability of these data and easy-to-use tools for analysis will encourage faculty adoption of effective teaching methods, which in turn will lead to enhanced student learning. The research team for this project combines experts from physics education research, faculty development, computer security, and data mining and visualization.