

Physics departments are under increasing pressure to assess the student learning outcomes of their classes and programs in order to reduce Drop/Fail/Withdraw rates, maintain program size, and receive or renew programmatic (e.g. with ABET) or departmental accreditation (e.g. with regional higher education associations). The field of physics education research (PER) has made significant progress in developing research-based assessment instruments, techniques for formative assessment, and alternative assessments for complex learning goals. However, there is a wide gap between the language and goals for assessment used by physics faculty members and department chairs and those used by physics education researchers. This gap results in a disconnect between researchers who do not answer the questions about assessment that most matter to faculty, and faculty who do not use assessments that are informed by research. The goal of this project is to build a bridge between these two groups by providing tools (online assessment resources and synthesis research) to arm faculty to do better assessment, and professional development (a workshop and online support for physics department chairs) to teach chairs, as agents of change, how to use those tools. This work will have three major impacts:

1. Department chairs will learn to assess learning in their departments in a way that is consistent with their goals and language and connected to results in PER, thus meeting their need for assessment tools and transforming the way assessment is done in physics departments throughout the country.
2. Physics education researchers will increase their understanding of the assessment needs related to program review, resulting in improved tools to meet these needs and potential new areas of research.
3. Assessment is a gateway drug that will lead to increased adoption of evidence-based teaching. By arming chairs with good assessment practices tied to their needs and goals, this project will give them the tools to engage their departments in a systematic process of examination and improvement of teaching and student learning. We will facilitate the connection between assessment and evidence-based teaching by connecting online assessment resources to existing resources for PER-based teaching methods on the PER User's Guide (<http://perusersguide.org>).

This project will achieve these impacts through the following activities:

- **Develop online assessment resources** including (1) a guide to the research behind and the use of many different types of formative and summative assessments, (2) a comprehensive collection of overviews of PER-based assessment instruments, and (3) a database system to collect and analyze results of research-based assessments. These resources will enable all other activities in the project.
- **Survey chairs** to identify the questions about assessment that are most important to them.
- **Develop an in-person workshop and online follow-up for department chairs** on incorporating PER-based assessments into their departments and developing departmental assessment plans.
- **Develop online modules and guides to address the questions identified by the survey** (example questions may include "How can I identify which students are going to fail out before they fail out?" and "How do I connect ABET criteria with student learning?")
- **Conduct synthesis research** to analyze data collected through the new assessment results database and the existing rapid analysis and web reports (RAWR) system in order to assess the state of PER-based teaching and answer research questions relevant to department chairs.

Broader Impacts: This project has the potential to transform how both assessment and teaching are done throughout the country by increasing the use of decades of physics education research. The impact will be maximized by targeting physics department chairs, who are already deeply motivated to do assessment for departmental and accreditation reasons, and are in positions of authority and able to affect departmental change. Assessment will start the transformation in an area where chairs are already eager for new tools, and leading naturally towards evidence-based teaching.

Intellectual Merit: The PER community has developed dozens of research-based assessment instruments, which have been given to many thousands of students throughout the country. However, the results of these assessments have not been collected or analyzed systematically. This project will create an assessment results database that will collect results from around the world and synthesize these to provide an overview of the state of PER-based teaching. Synthesis research will include updating and expanding the 1998 Hake study to compare the impact of many PER-based teaching methods in a variety of environments, and reinterpreting existing data sets to answer chairs' authentic assessment questions.