

## Collaborative Research: Resource of Open Problems for Education (ROPE)

The proposed project will develop an online, electronic library, the Resource of Open Problems for Education (ROPE), that will provide many innovative, well-tested, and documented problems that mathematics instructors and students can use in a wide range of courses and assignment types. Any user will be able to search this library for problems by course, topic, type of problem (e.g., numerical, symbolic, etc.), level of difficulty, and other characteristics; and by keyword or problem text. Problems will be contributed by the community of users and will have associated descriptive information that will include user feedback and comments, as well as statistics on the frequency of the problem's use. Users will be able to rate problems using a commonly understood "endorse" feature (similar to those used on social networking sites), create and share collections of problems they may refer to later for homework, quizzes or exams, and comment on problems for the benefit of other users. The library will support different problem formats, the ability to translate between them, and will be able to interact with other applications (for example, online homework systems) to provide problems for them.

### Intellectual Merit

The Resource of Open Problems for Education (ROPE) will address a current need in undergraduate mathematics education: the need for a widely-available source of high-quality, well documented problems that instructors can use in a variety of educational venues. Much of the learning that takes place in mathematics is driven by students' work, and the success of that learning is fundamentally dependent on the types of problems on which they work. ROPE will provide a resource that will be *free and open-source*, providing problems for users without commercial entanglements. Because it will have a powerful search capability, users will be able to easily find problems that allow them to address their needs for instruction or learning. It will allow users to create *collections of problems*, and *collections of collections*. This capability will allow many individual use-cases: for example, instructors may construct homework sets, quizzes, and groups of these for entire courses; or may construct model courses with supporting material that they can then share with colleagues; etc. And it will support a *community of users* who may contribute problems, content and feedback on problems, and who may share their work and problem collections with others. All of these characteristics, taken in sum, will result in a widely accessible and useful resource that may have a significant impact on mathematics education as a whole.

### Broader Impacts

The broad impact of ROPE will stem from its accessibility, ease-of-use, and extensibility. We expect that the largest group of users of ROPE will be faculty who are browsing for additional homework, test, or quiz problems for their courses, and constructing collections for their courses.

ROPE will also provide problems for users and authors of open-content and conventionally published textbooks, and will be particularly useful for open-content texts. The PIs for the project have extensive contacts with faculty in a large number of institutions and communities of faculty, including Project NExT, those interested in inquiry-based learning, and open-content authors, which will allow for effective dissemination to those groups most likely to use the resource. Because ROPE will support flexible collections of problems and collections, instructors will be able to use it in many different ways, and it should have commensurately wide impact. In addition, the flexibility and extensibility of its design will mean that ROPE can meet the changing needs of faculty in the future and make connections with other software projects for which a library of open problems will be useful. We therefore expect that ROPE will have broad impact, reaching instructors at all types of colleges and universities who are teaching any standard mathematics course in any of a number of different ways. We further expect that as ROPE develops we will be able to extend it to include other disciplines, further increasing its impact.