National Science Foundation
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Frequently Asked Questions (FAQ) for Engineering Education and Center's Research in Engineering Education program

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Logistics

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OVERALL PROGRAM GOALS

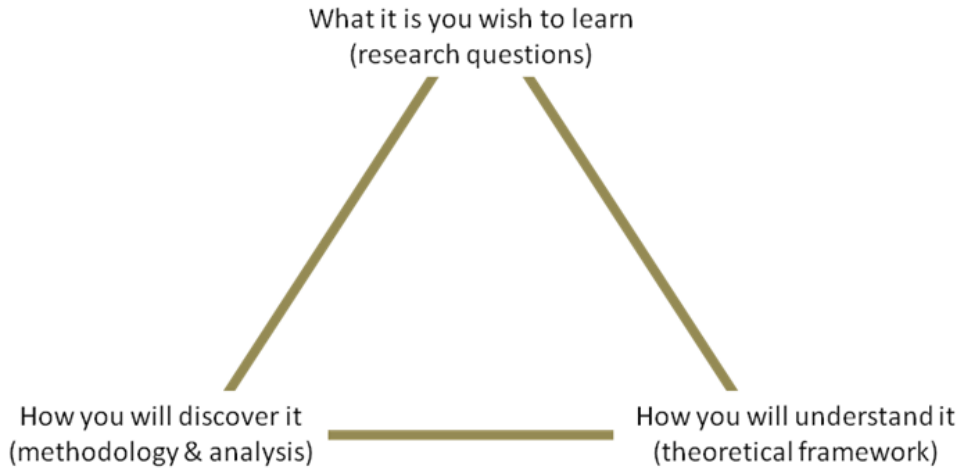
1. **What are the overall goals of the REE program?**

The REE program focuses on understanding engineering education from an engineering perspective- as a complex system that can be optimized to meet specific societal needs under given constraints. Proposals are sought that will help engineering faculty, educators, and administrators understand this system, effectively engineer desired changes, and produce more qualified graduates. By combining the full spectrum of engineering methodologies and understanding of complex systems with research on learning, the REE program seeks to inform meaningful change in the engineering education system.

2. **How do I determine if my project is a good fit to the REE program?**

   The best way to determine if your ideas fit the program is to contact the cognizant program officer via e-mail or by phone. All potential PIs are strongly encouraged to contact the program director prior to proposal preparation.

   Successful REE projects clearly discuss what they wish to learn, how the knowledge will be discovered, and the theoretical basis that will allow necessary insights. These three elements should be as aligned with each other as possible, as shown in the figure below, for the proposal to be competitive for funding.



3. **Five areas of interest are listed in the program description. Does my proposal have to address one of these five areas?**

   The five areas outlined in the project description give broad, overlapping, and synergistic areas of interest for the REE program. Many research topics in engineering education overlap one or more of these areas. However worthy ideas outside these areas are actively sought. All potential PIs are strongly encouraged to contact the program director prior to proposal preparation to discuss ideas.

4. **Can you provide additional details on the types of projects that fit into the five areas of interest in the program description?**

   The REE program does not seek research on specific topics or outcomes. Rather this program seeks to support the best community-generated ideas that will both advance the frontiers of knowledge and inform beneficial changes to the engineering education system.

   The five areas defined in the program description are designed to support the overarching goal of understanding engineering education as a human-engineered system. More

specifically:

- *Diversifying pathways to and through engineering degree programs.* A large number of potentially talented engineers do not find their way into engineering degree programs, or leave engineering once they enter college. How can the engineering education system be engineered to support the needs of groups, including those traditionally under-represented in engineering, that may have unique qualifications or interests, but are currently not well served by existing curricula? A specific example is military veterans. Veterans often have technical experience, but do not fit the profile of traditional students and seek to complete a degree in three rather than five years due to the support offered from the Post 9/11 GI Bill. How can programs offer degree programs that meet the needs of, and that build upon, the life- and professional experiences of veterans? The do-it-yourself community, commonly called "makers" or "hackers" is another example of individuals with specific real-life skills related to engineering. Adapting programs to meet the needs of diverse groups may require experimentation with disruptive innovations such as creating alternative curricular pathways or rethinking how student achievement is measured. While program funds are not sufficient to support wide-scale change, forward-looking ideas, test-beds, and models are actively sought.

- *Exploring credentialing in engineering education.* This part of the program seeks to understand how the means by which learning is measured and certified affects engineering education. For example, understanding how and for whom grades can motivate performance in engineering degree programs would fit into this element of the program. The program is also interested in how learning credentials are valued outside the university, by potential employers for example. Another area in which research is sought is exploring new credentialing mechanisms, particularly those that can help to allow student to earn some form of credit for engineering activities that are conducted outside the classroom; i.e. make a more porous boundary between formal and informal learning. Projects in this area should engage a spectrum of partners to ensure that innovations in credentialing have the potential to diffuse broadly.

- *Understanding how to scale engineering education innovations.* This area focuses on research on effectively adapting, diffusing, or scaling discoveries in engineering education for broad societal impact; i.e. the process of innovation in engineering education. While there have been significant inroads on understanding how students learn, effective methodologies have been slow to propagate throughout the education system. Research is sought to discover what characteristics of the engineering education system limit diffusion of new ideas, how to overcome barriers to translation and adaptation of effective practices, and how to efficiently scale disruptive innovations. There are questions on what scaling entails in engineering education. While much research in engineering education is driven by externally identified needs (often identified by national panels), innovation also requires the identification of value. Research to clarify the value proposition of engineering education may help the system "pull" innovations into curricula rather than having them "pushed" by needs. Of particular interest in this element of the program is developing models of the engineering education system that may be capable of identifying leverage or tipping points on which future investments should be focused. Foundational work on modeling engineering education as a complex, adaptive system or developing meaningful representational schematics of learning and learning systems is highly sought.

Advancing engineering learning in broader eco-systems such as innovation, globalization, or sustainability. Discoveries from engineering research can have significant impact on the economy and society. This is particularly true of engineering education research since it informs workforce development. In order for engineering graduates to succeed in a rapidly changing economy and society, they must have the communication and teamwork skills to function in highly inter-disciplinary environments, and additionally understand the multiple broader contexts in which engineering work is situated. It is unclear, however, how the engineering education system can, at scale and at reasonable cost, respond to the need to create graduates who understand both the broader contexts of their profession as well as maintain the existing strong technical expertise of graduates. Research on how such skills can be rapidly and seamlessly integrated into the education system is needed to allow degree programs to rapidly adapt to societal changes.

- *Developing engineering-specific learning theories.* The engineering education system is designed to produce highly qualified graduates to fill critical workforce needs. To design, optimize, and implement effective education systems it is critical to establish a rigorous, scientific basis for how engineering students learn in given environments. Since the engineering education system is designed to create a professional workforce, it is also important to understand the needs of society, the engineering profession itself, and how students come to identify themselves with this profession. The long term goal of this element of the program is to develop engineering-specific theories of learning that can broadly inform engineering degree programs. Given this focus, potential PIs who seek to adapt learning theories shown valid in related disciplines to engineering should make a strong case for the utility and novelty of such work. Why do you expect these theories as currently defined not to apply to engineers? What new will be learned? Similarly proposals which will utilize a grounded theory approach should discuss in detail how analysis of data will lead to theory development, and how the new theory will integrate with existing theories. Proposals which seek to develop infrastructure to support engineering education research will be considered if they have potential for broad adoption. Such infrastructure may be new measurement instruments, cyber-tools, or creating and supporting networks of people empowered and trained in engineering education. Proposals which seek funding for instrument or tool development should make a strong case for the need of such tools in undertaking basic research and outline a roadmap to ensure wide adoption. Tool development is likely more appropriately supported in the TUES program. Support for these and similar activities is appropriate to this program.

Across these five areas and the entire domain of engineering education research the REE program reserves some funding for risky, highly transformative, "blue sky" ideas that can inform significant and disruptive change.

PROPOSAL PREPARATION

5. **I can't seem to find the proposal solicitation document on the NSF web site. Where is it?**

   REE is a program description, and does not have a separate program solicitation. All pertinent details about the program can be found on the Research in Engineering Education program description web site: http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503584. Proposals to NSF must be submitted electronically via either the NSF FastLane System or Grants.gov.

Proposals submitted via FastLane should be prepared and submitted in accordance with the general guidelines contained in the NSF Grant Proposal Guide (GPG). The complete text of the GPG is available electronically at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg. Proposals submitted via Grants.gov should be prepared and submitted in accordance with the NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov. The complete text of the NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at: (http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide).

6. **Does this program fund initial investigations only, or can I apply to continue a project that is ending?**

   Renewal of existing projects will be considered. To be competitive for continued funding, results from the prior project must be discussed and a strong case for continuation of the research be made based on prior results. PIs are also encouraged to address how the project will be weaned from NSF support during the continuation funding period, particularly how other funding sources will be identified and implemented. Any proposal submitted must be responsive to the current program description and meet the NSB approved merit review criteria.

7. **I have an idea to create a new course, series of courses, or laboratory for engineering students. Can this be funded through the REE program?**

   The chances of being funded are slim. The REE program funds *research* in engineering education that is generalizable and/or transferable. If the course(s)/lab will be the vehicle through which the research is done, then a better case for funding can be made. The review of the proposal will be based on the research, however, not on the novelty or importance of the course(s)/lab. The Transforming Undergraduate Education in STEM (TUES) program in the Division of Undergraduate Education is more suitable for such development projects.

8. **What are the most common issues with REE proposals that reviewers identify?**

   In no particular order:

   - The PI fails to provide a roadmap for eventual impact.
   - Insufficient description of prior related work. The proposal fails to place the work in the context of existing literature and/or to make a case for why the work will add coherently to this literature.
   - No clear research question.
   - A research question that is too broad. The proposal does not focus on a question that can be investigated given the constraints of time or resources available to the project.
   - A course/lab/curriculum development proposal that does not advance understanding of how engineering students learn or of the engineering education system.
   - The methodology and/or research plan are deficient. For example, a quantitative study is proposed but the number of subjects is likely not sufficient for significant effects to be discerned. Quantitative proposals should discuss the statistical power of their experiment.
   - Lack of an appropriate theoretical framework that will be used in the research.
   - The project does not clearly identify how the work draws from practice and/or does not clarify how practitioners will utilize the research results to impact how students learn.
   - Failure to identify an appropriate audience for the research results and dissemination plans. For example many proposal state they will publish in engineering education journals, but a more effective audience for the results are administrators or staff who do not regularly read

these journals.
- Not having the right team to achieve meaningful dissemination.
- The proposal fails to identify the potential impact of the work on the engineering education system by providing a roadmap for future impact.
- No clear value proposition is stated.

9. **Is an external evaluator required on REE proposals?**

   The need for external evaluators depends on the size and complexity of the project. While project evaluation is always beneficial, it may not be suitable for smaller projects. Contact a program director if you have questions.

10. **Are interdisciplinary partnerships required on REE proposals?**

    Yes. Most engineering education research projects require both technical engineering knowledge as well as knowledge from cognitive/education sciences and benefit from interdisciplinary partnerships.

    Large projects with multiple partners and outcomes may not only need faculty from several disciplines, but external evaluators, project managers, and individuals who can help ensure that the project has meaningful impact. If you have questions, please contact the program director.

LOGISTICS

11. **Can I submit more than one proposal or serve as a PI on one proposal and a co-PI on a different proposal?**

    Yes. There is no limit on proposals per PI or institution.

12. **I am part of an NSF research center which includes an education mission. Can I submit an REE proposal?**

    Yes. However the proposed REE research must address research questions not already funded in the center's award. We particularly encourage submissions from ERCs in their early phases since the ten year mission of ERCs allows longitudinal studies to be conducted that are difficult to perform otherwise.

13. **What are the duration limitations on REE projects?**

    There is no specific limitation on the duration of the awards other than limitations included in the GPG. The proposed duration should be consistent with the scope of the proposed effort and the funding requested. Typically projects are 2 to 4 years, and exploratory projects are typically somewhat shorter.

14. **Are REE proposals eligible for supplements?**

    Except in specific circumstances that bar supplemental funding, REE projects may request supplements.

15. **What funding opportunity number do I choose on Fastlane or Grants.gov?**

    Submit to PD-1340.

16. **What is the upper (lower) limit on what I can request for my project?**

    Proposals are evaluated based on their value; value is defined as the potential benefits divided by the project's cost. To determine the potential benefit, proposals are rated on both their intellectual merit and potential for broad impact. The cost of the proposal is determined from the budget. PIs are encouraged to explicitly state the value proposition of the proposed work, and ensure a high value by maximizing potential benefits while minimizing costs.

    This approach allows small, exploratory projects with low costs to have high value while at the same time allowing larger projects with large benefit to have proportionally higher costs and maintain a high value proposition. Small, exploratory, and speculative projects with a clearly stated value proposition are encouraged in this program.

17. **Fifteen pages is not enough space to fully describe the project. Are appendices allowed?**

    No.

18. **I have a project with several partners. Should I include them as co-PIs, consultants, or submit collaborative proposals?**

    This is up to the PI and the organization(s) submitting the proposal based on what is most suitable for the proposed project.