Getting Started with an Adaptation and Implementation Grant

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Introduction

The goal of the Course, Curriculum, and Laboratory Improvement (CCLI) program at the National Science Foundation is to improve the quality of science, technology, engineering, and mathematics (STEM) education for all students. The activities funded seek to improve student learning environments, course content, curricula, and educational practices.[1] The program has four tracks. "Adaptation and Implementation" projects adapt and implement exemplary educational materials or practices or laboratory experiences that were originally developed at other institutions, whether academic or commercial. "Educational Materials Development" projects either develop "proof of concepts" for new textbooks, software, or laboratory materials or else fund the complete development and national dissemination of such products or practices. "National Dissemination" projects involve the development of workshops, short courses, or similar activities to allow faculty to learn new content or educational practices to incorporate into their classes or laboratories. And "Assessment of Student Achievement" projects look at the development of new assessment tools and procedures.

The author of this paper has written a successful Adaptation and Implementation grant proposal entitled "Development of a Laboratory Curriculum Devoted to the Thermal Management of Electronics". The goal of this paper is to give guidance and recommendations to people considering writing such a grant proposal. These recommendations are based both on her own experience and also on recommendations from several other principal investigators who have written successful proposals.

Adaptation and Implementation Track Overview

A&I projects fall into two categories, both of which have the goal of improving STEM education within a department, across several departments, or even among several institutions. As discussed above, both tracks require the adaptation and implementation of educational materials or practices or laboratory experiences that have been successful at other institutions. The first type of project involves direct improvement of the curriculum, while projects in the second category examine barriers that prevent the improvement of education and suggest solutions.[1] Below is a sampling of CCLI- A&I projects that are currently underway that illustrate the types of projects that are funded. A complete list can be found on NSF's Fastlane web site.[2]

- Collaborative Research: Adaptation and Implementation of Activity and Web-Based Materials into Post-Calculus Introductory Probability and Statistics Courses

- A Comprehensive Plan to Improve Mineral Science Instruction Using Project-Based Learning and XRD Analysis
- Collaborative Research: Adapting and Evaluating Online Materials for Undergraduate Statistics Using LON-CAPA Technology
- Developing a Research-Rich Introductory Biology Curriculum
- Towards an Integrated Polymer Education: Development of Biodegradable Polymer Laboratory Unit
- Adaptive Online Laboratory in Computer Science Education
- Bug Power: Fueling our Future with Microorganisms
- Remotely Accessed Energy Laboratory
- Collaborative Research: A Novel Approach in Improving Power Electronics and Electric Drives Courses, Curriculum, and Laboratories: Multi-University Adaptation and Implementation
- Implementation of a Virtual Control Room in the Integrated Science, Business and Technology Program
- Development of a New Undergraduate Science Service Course to Attract Hispanic Students to Science: Geography, Resources, and Environment of Hispanic America

The first type of project involves the adaptation an implementation of STEM materials developed elsewhere for the purpose of enacting specific changes in the curriculum. As one can see from the list above, a majority of the A&I projects are of this type. The materials may come from several different universities, and even experiments or training materials from industry may be used. The effects of these materials and practices on the original institutions should be highlighted. The developers of the work being adapted must be cited, and it is beneficial to include them as consultants. The projects should not merely copy the work of another institution but rather should adapt it in unique ways. Students should be involved in the project, whether that be in designing and building experiments or in offering their guidance in the development of new curricular materials. Work may address a single course, entire programs, or even curricula in several different disciplines. Funds may pay for equipment (which requires 50% cost-sharing for most universities), supplies, faculty time, student assistants, travel, and other miscellaneous items. Expected funding levels are up to $100,000 for work affecting a single course and $200,000 for more comprehensive projects.

The proposal solicitation lists the following outcomes for this first project type:

- "*Adaptation and implementation* of exemplary practices and/or materials for course, curriculum, or laboratory improvements in innovative ways.
- An *evaluation* that informs the institution and others of the *effectiveness* of the implemented materials and practices in improving student learning, and also guides development of the project.
- *Faculty professional development*, as needed, in support of curricular adaptation and implementation.
- Efforts to build on the project and to *broaden its impact* at the institution, within the discipline or across disciplines.
- Effective *dissemination* of project results to the broader community.[1]"

Each of these outcomes will be evaluated by the reviewers and thus should be explicitly addressed in the proposal.

As discussed above, the second type of project supports work to overcome identified barriers to curriculum reform. The proposals should describe the barrier(s) being overcome, the steps that will be taken to overcome those barriers, and the evaluation methods, as well as the long-term curricular goals of the project. A variety of exemplary STEM materials should be examined and evaluated, and suggestions for implementation should be made. These projects should involve input from both faculty and students. The proposals should not come from an individual but rather a group working together to conquer the problem identified. As with the first type of project, the materials and practices of other institutions that are to be evaluated should be identified, and how they will help meet the goals of the project should be clearly discussed. Expected funding levels are up to $75,000.

The program solicitation lists the desired outcomes of Type II projects:

- "*Lowering of the challenges or barriers* that were defined in the proposal.
- A description of the exemplary curricula, materials, and/or practices that were explored by the group and the *progress* that has been made *toward implementation* of curricular reform.
- A summary of *student contributions* to the project.
- An *evaluation*, using the benchmarks defined in the proposal, that informs the institution and others of the progress made toward the goals defined in the proposal.
- Effective *dissemination* of project processes and results to other members of the proposer's academic community.
- A specific *plan*, including a timeline, for continuing the reform that was initiated at the participating institution(s) as a result of the project.
- *Submittal to the appropriate academic office*r at the institution(s) of the *evaluation results* and the specific plan for continuing the reform.[1]"

For both types of projects, the pedagogical and technical research base related to the work should be clearly referenced and summarized. Proposals must show a comprehensive and up-to-date understanding of the research base, and the relationship of the proposed work to the research base should be discussed. Recently an increased emphasis has been placed in A&I proposals on highlighting and contributing to this research base.

Recommendations

The following recommendations come from the author as well as Jeffrey McKinnon (University of Wisconsin-Whitewater) and Paul Ohmann (University of St. Thomas), all of whom have current CCLI A&I projects.

- Start early. It will take longer than you think to write your first grant proposal. You must research your idea, get other faculty involved, and solicit letters of support from industry. All this takes time. Starting six months before the due date is good. The author began her grant proposal in June when it was due in November, and the amount of time

was adequate. Remember that most university grant departments will need at least several days to collect necessary signatures before your grant can be submitted as well.

- Contact the program director to discuss your idea. He or she will be happy to confer with you about your project and whether it fits in with the goals of the A&I track of CCLI.

- Choose a topic that fits with your experience and institution. If other people have similar ideas, why should you be the one to do the work? You should have experience in the area (documented with publications), and you will need to show how your project fits in with the goals of the institution. Show how your department and/or institution will be actively supporting your project. The reviewers of the author's proposal were pleased to see how her project, dealing with the cooling of electronics, fit in with the needs of the industry in Silicon Valley where her university is located.

- Do not work alone. Having multiple PI's, especially if they are from multiple departments or institutions, shows a greater possibility for widespread curriculum improvement. Invite Co-PI's to your project who bring needed expertise and proven qualifications. Involvement of other institutions, even if limited, is a positive factor. The reviewers of the author's proposal liked that fact that she will be taking her students on a tour of one of the UC Berkeley labs related to measurement of nano-scale thermal properties.

- Perform a comprehensive technical literature search, and cite your references in the text. You need to know where the cutting edge of research in your field is.

- Perform a comprehensive educational literature search. This search falls into two categories. First, you must be adapting materials and practices developed elsewhere. You can find these practices by examining the educational journals and conference proceedings in your field as well as doing internet searches. You need to cite both their practices as well as the effect that these practices have had on their institution(s). Second, you should cite pedagogical material in your field and explain what innovative or successful pedagogical practices you will be using.

- Develop a national model. While you need to base your work on what others have already done, your combination and adaptation of materials needs to be innovative. Show that your work could become a national model for other institutions to follow.

- Along with that, show how your project could make your discipline appeal to a wider audience, thus increasing the diversity of your field. Explain the benefits to the students clearly, but do not exaggerate them.

- You must realize that NSF does not support projects based on need. They will not fund very basic equipment that the department should be purchasing.

- Get letters of support from industry in your area. Even if they cannot promise equipment or money, letters stating specifically how this project would benefit them are helpful. If

you are relatively unknown in your field, getting a letter from some of the academic leaders in the field can also be beneficial. The PI had four letters of support from industry and two from leading academicians, one of whom promised to allow our students to come visit his research labs. Of course, letters promising equipment or money show a much stronger level of support and therefore are preferred.

- Note that equipment must be cost-shared, but nothing else. In the past, cost-sharing for similar grants was required for the entire budget. Letters of support from industry can be helpful in providing that cost-sharing.

- Be realistic in your budget and timeline. It is a very common problem of young PI's to over-estimate what one can accomplish in a specific period of time. Be especially careful if you will not have a graduate student working on the project through an assistantship. As for the budget, NSF most likely will not give your project higher priority if the budget is small. They want to know that you can accomplish your work with your budget. While you should not pad your budget, if the NSF likes your project but thinks the budget is too big, they will probably simply ask you to reduce your budget.

- Find an outside evaluator for your project. It is best for you not be the one assessing the results of your own project. An outside evaluator does not necessarily have to be expensive. The PI found a psychology professor willing to oversee a graduate student who will be preparing surveys and compiling results. The people performing the assessment should have some qualifications and experience in educational assessment.

- Finally, have a detailed dissemination plan. If other people are to adopt your project for their own institutions, they must know about it! Having a web page for the project probably is not sufficient. The author discussed how she will make presentations at the ASEE conference and possibly a local ASME meeting. At the conference she will be asking for contact information of people who are interested in the cooling of electronics curricula. Then the web page can be used to trade class projects, course syllabi, and laboratory experiments from hopefully a wide variety of people. Finally, high school students at the university for open houses and industry members who work in the area will be invited to tour the lab, and industry members will be invited to review course syllabi and lab experiments and make suggestions for continual improvement.

Conclusions

CCLI A&I funding has been an effective source of curriculum improvement in many institutions. This paper has provided an overview of the A&I track along with recommendations for people writing A&I proposals. Of course, the best and most basic advice is to follow the guidelines in the proposal solicititation[1] and the Grant Proposal Guide[3] closely. Additional information can be found in NSF's "A Guide for Proposal Writing[4]" and "Supplemental Information for Principal Investigators and Applicants to NSF's Course, Curriculum, and Laboratory Improvement Program.[5]"

References

[1] National Science Foundation web site, "Course, Curriculum, and Laboratory Improvement (CCLI) Adaptation and Implementation (A&I) Track," Program Solicitation NSF 03-598, http://www.nsf.gov/pubs/2003/nsf03598/nsf03598.htm.
[2] National Science Foundation web site, "Award List for Program: CCLI-ADAPTATION AND IMPLEMENTATION," https://www.fastlane.nsf.gov/servlet/A6QueryList.
[3] National Science Foundation web site, "Grant Proposal Guide," http://www.nsf.gov/cgi-bin/getpub?gpg.
[4] National Science Foundation web site, "A Guide for Proposal Writing," NSF 98-91, http://www.nsf.gov/pubs/1998/nsf9891/nsf9891.pdf.
[5] National Science Foundation web site, "Supplemental Information for Principal Investigators and Applicants to NSF's Course, Curriculum, and Laboratory Improvement Program," NSF 00-117, http://www.nsf.gov/pubs/2000/nsf00117/nsf00117.pdf.

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