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ABSTRACT

The National Science Foundation (NSF) is an important part of the teacher enhancement landscape. NSF can help investigators by providing information on funding directions, and how shifting trends affect how proposals are evaluated. This paper provides information on proposal development, specifically computer science teacher enhancement efforts. Criteria that is pertinent in many domains of teacher enhancement is also addressed. (CCM)

The Good, the Bad and the Disappointed: A Review of NSF Funding of Computer Science Education for Secondary Schools

by
Michael R. Haney

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The National Science Foundation is an important part of the Teacher Enhancement landscape. TEECH can serve to increase communication between current and future Principle Investigators and NSF program officers. NSF can help by providing information on funding directions, and on how shifting trends effects how proposals are evaluated. Mike Haney (Program Director, Elementary, Secondary and Informal Education) has started this process off by providing us with a current lecture on proposal development entitled 'The Good, the Bad and the Disappointed: A Review of NSF Funding of Computer Science Education for Secondary Schools'. Although this paper specifically uses computer science teacher enhancement efforts in its examples, the criteria addressed in the paper are pertinent in many domains of teacher enhancement.

The Good, the Bad & the Disappointed: A Review of NSF Funding of Computer Science Education for Secondary Schools

by
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Background...

NSF funds Basic Research and Education ...
Within Education, there are a number of divisions. The ones that fund computer science are:

- Division of Undergraduate Education, which funds projects for undergraduate education, which includes preservice teachers. (www.ehr.nsf.gov/EHR/DUE/start.htm)
- Elementary, Secondary and Informal Education, which funds inservice education and K-12 course development in three programs: (www.ehr.nsf.gov/EHR/ESIE/index.html)
  - Teacher Enhancement
  - Instructional Materials Development (materials for student use)
  - Informal Science Education (museums, community, scientific literacy)

Most programs at NSF require prelims. These are used as sounding boards for your ideas. They are read by several program officers who will return written comments and suggestions to you. For ESIE, prelims are mandatory, and a full proposal cannot be submitted unless a prelim was reviewed first (except for resubmissions when the guidelines have not changed).

Full proposals are reviewed by a peer review panel, usually between 4 and 9 outside experts who advise NSF on funding. Because of this process, it is critical that the proposal you write be self-explanatory and convincing to people with a variety of expertise: content discipline, teaching methodologies, evaluation, school change, curriculum implementation, etc.

The Good

Teacher Enhancement awards about $100M per year in teacher inservice projects, including planning, conference and other grants. Often a large portion of these funds are for special initiatives. In the five years I have been at NSF there have been funds earmarked for:

- Private Sector Partnerships,
- Local Systemic Change, Elementary Math & Science,
- Local Systemic Change in Secondary Mathematics,
- Advanced Technological Education,
- Local Systemic Change, Secondary Science (will be coming soon...)

The Bad You are shooting at a moving target. The expectations of proposals are changing. Many proposals funded three years ago would not be acceptable now. Below is a history of a few computer proposals and the reviewer ratings they received. Those in **green** were funded.

The History-10 CS (?) proposals with their panel ratings. **Funded are in green.** description	1992	1993	1994 1st	1994 2nd	1995	1996
18 graduate credits in mathematics and CS for a 29 month project	EVGF 2.5					
2 yr $300K upgrade cs and near-cs teachers to IEEE & ACM standards	EEVGP 2.6	**VVGG 2.5 wd**				
42 mo $600K for math/cs teachers learn computational science		VGGG 2.25	**EVVGGF 2.5**			
22 mo $270K adding lab component to AP		GGFF 1.5				
2 yr $160K upgrade teacher content in CS		PPPPP 0				
3 weeks $47K "analytical and computational methods"		GGGF 1.3				
3 yr $1.6M computer science & integrated applications			GGGFFP 1.3	GGGGFFVVVG 2.1		
3 yr $600K teachers statewide to be local technology experts-MS			VVGFF 2		**EVVGGG 2.7**	
1 yr $100K AP teachers learn C++						GFF 1.3
3 yr $200K rural teachers to be technology experts						GFF 1.3
The number of Computer Science conferences that were funded		1	1	1	1	2

...some of the disappointments...or general failings of proposals

- Far too much is promised...
- Projects must involve teachers at all stages of the project.
- The project staff members are not qualified in all aspects of the project (content, pedagogy, materials, etc.).
- A broad committed (collaboration) is needed to make this project work.
- Computer Science is used to fragment in the curriculum (ex., another language course) rather than consolidate (ex., computational science).
- The cost per student not justifiable. It should be less than $4K.
- The project is too narrow or elitist, with little appeal to most students.
- The goals, objectives, strategy, outcomes and evaluation plan are weak so little will be learned from the project.
- NSF support would be used to expand the university course catalog.
- PI motivation is doubtful (self serving) and not linked to the community's view of what is needed.
- Too few details are provided, especially about workshops, what is taught and how it is taught.
- Tuition is charged even though the project includes salaries and indirect costs.
- Finally, it should be noted that projects that simply add a new language are an unlikely area for support.

The following as samples from reviews of various projects.

1. oh, so much to do in so little time

"Far too much is promised (covered) in far too short a time. The proposal also had many problems. It was very ambitious and too broad in scope. It tried to do too much for rural schools through individual teachers. The topics in the first year include object oriented design, GUI, libraries, e-mail, HTML, spreadsheets and others. The final year included events, JAVA, math, machine simulator, BNF, state diagram, Mathematica. Through all this, the participants have long- and short-term projects in the summer plus the additional burden of their new roles in schools with which to deal."

"Another concern of the panel was that the proposed project includes a lot of material to cover in four weeks. Although these are very bright and motivated teachers [...], they have not encountered the computer concepts of objects, classes, inheritance, virtual functions, dynamic binding, and so forth. If the project is primarily for teacher enhancement, then the PIs need to show how this is feasible to accomplish in the summer."

"A detailed syllabus would have helped this proposal substantiate the claim that so much could be covered in four weeks."

"The project had many deficiencies in the design. For example, the teachers would have one week to learn C. This is unreasonable. Moreover, there was no justification for learning C provided."

"Although the PI's have experience with intense summer programs like this, the number of topics and speed of the courses undermine some of the project's strengths such as the hands-on learning. It appears teachers would have little time to experiment and discover when the pace is so quick. The project does not include any additional time compared to the prior project but does include many more topics."

"The syllabus is overwhelming. In the first summer (5 weeks) they will study Prolog, Computer Architecture, Lisp, and some C++. In the second 5 weeks one year later, they will finish C++ and cover operating systems, languages and compilers, basic data structures, graphics, artificial intelligence, and data bases. The teachers do work on these in the intervening academic year independently with support through e-mail."

2. you must involve teachers

Teacher enhancement must involve teachers at all stages and in all phases of the project. The following are from reviews of projects that failed to do so.

"The PI should have made a much stronger case for the need for the workshops, especially considering the attendance at the previous workshop. The model for this workshop is a very old one that NSF no longer supports. This is a one-shot teacher institute without any form of follow-up. Teachers were not involved in the planning of the new workshop and some of their important suggestions from the survey (such as more applications) seems to have been ignored. In fact, much of the proposal was a copy of the previously funded proposal."

"Teachers are the clients of this proposal and not involved in the planning or administration of the project... "

3. staff qualified in narrow areas...

The project staff members are well qualified in their discipline(s) but not in methods and/or knowledge of schools. Examples follow.

"The PI did not seem to be aware of the diverse needs of the individual teachers. He did not seem to know how teachers could integrate what they learn into the curriculum."

"Many of the topics included in the course would not be of value to the typical high school teacher. Their relevance needs to be explained."

"The project seems to emphasize tools exorbitantly and almost to the exclusion of pedagogy. It may be that some of the methodologies do transfer with the teachers to their classrooms, but little time is given to how [this would happen] and much time is given to the what [would happen]."

4. partnerships...

Who is committed to making this project work? Examples.

"...Moreover, the project responds to what is only an implied need without data, letters of support, or a needs assessment."

"Small problems were in the limited cost-sharing, the need for specific data, and the lack of pre-college teaching experience. More serious were the lack of letters of support, an advisory committee, and the incomplete evaluation plan."

"The evaluation was based on student performance, it depicted XXX as a partner although there was no such letter of support, and would compare the treated teachers' students [test] results with the national population."

"The telecommunications component assumes that schools have the technology needed to support the teachers in the project. The workstation requirements perpetuate the model of one connected computer in a classroom, and the PIs have failed to envision anything that goes beyond the single connected computer in the school."

"This would have been a stronger proposal if it included networking commitments and support across the disciplines. At a minimum, the school should provide release time, real access to computers, and administrative support. Other commitments that would have been convincing would include computers for science and mathematics, scheduled school-wide working groups, and a LAN."

"Access to Internet is promised only during the project. Moreover, it is for lead teachers only. Who will provide (and what commitments have been made for) Internet access after the project? How do the peers whom these teachers are teaching get access?"

"After the project is over, many of the goals will have been met. However, it is assumed that once a critical mass is in place good things will continue to happen among the teachers and between teachers and the research community. There are no commitments to sustaining the impact?"

"The commitments made by the participant and the school district do not seem to include equipment of any sort."

"The only letter of support is from the grants office at the university."

5....just another fragment

"Computer Science is one additional fragment in an already too fragmented curriculum...the project is disconnected from mathematics, science or other parts of the student's life as the following show.

" In general, we believe (and TIMSS shows) that the American school experience is a mile wide (covers much) and an inch deep (achieved little deep understanding of anything). So why should computer science make this a mile-and-a-half wide?"

"The panel wrote that XXX has produced good quality products in the past. If the collaborative could provide a model for math and science integration then the project would be of value, but the panel was not convinced that this project does that. The collaboration needs to include other people who can integrate the standards and their applications through technology and who are in tune with math and science teacher needs."

"The most fatal flaw of the proposal is that it needs a stronger, clearer and more constructed tie to mathematics and science. The assumption in the proposal was that math and science teachers will be included; however, they are mostly taught computer science. To quote the panelists, 'The purpose of the project is to help science and math teachers integrate computers in the high school curriculum, but the proposal shows no evidence of how this will be done. The main focus of the proposal is missed by the activities. Only one course has topics relating to math and science curriculum.'"

"There were several major concerns raised about the appropriateness of more fragmentation of the high school curriculum. Also troublesome to the panel was the ability of these PIs to address what is a complex issue, the role of computer literacy in schools. Another practical concern of the panel was fitting one more course into the curriculum. This is not a programming course, it is more history of computing, problem solving, algorithm development, and a look at careers. Why were these not tied into the math or the science goals. The basic premise seemed to be that computer science is an alternative to high school science. The panel was not convinced."

6. cost per student

The cost per student out of proportion with the benefit, or with the projects against which it competes for funding.

"The proposal raised additional issues such as: Where is the math and science curriculum in this project? How is the curriculum developed? The cost per teacher would have been $9.18K, although approximately 720 additional teachers would be reached indirectly depending on the [the project]."

7. narrowly focused or elitist...

The project is narrowly focused or elitist. In general, AP has been considered too narrow for IMD support.

"This appears to be aimed at building a foundation to selling a book to be published. Many text books now come with XXX."

"The teams, which are a strength of the project, essentially do not exist other than in the summer. There are no details about how any interaction could be sustained and no plans to offer activities, networking, workshops, etc., during the school year."

8. goals, implementation, outcomes

Connect project goals, objectives, strategy, & outcomes. You need to evaluate how well these are accomplished

"The assessment was felt to be extremely test driven with pre- and post-tests as well as projects."

"Evaluation and long term goals were very sketchy. The evaluation plan is that the school would provide a letter."

"The evaluation plan is quite vague. For example, in the second part of the plan (the outside evaluator) has complete access to all the records and materials. There is no indication what he is trying to assess. In another phase, the participants are invited to "comment on the impact that the project has had thus far on the teaching of mathematics and computer science." Again, there is no indication what goal or objective is being assessed."

9. a cheap way to expand the course catalog

NSF is being asked to pay for new or token additions to the university course catalog and little else is accomplished.

"The concept of creating a knowledgeable cohort of teachers in the state on networking is excellent and this might be a national model, but this project includes just one Internet course and little else new. Consequently, this project looks much like an effort to raise enrollment and get masters degree students for the university."

"The proposal has admirable goals but ambivalence in reaching them. Masters degrees would be the focus of the project to produce master or leader-teachers for the communities. However, only one course would be on networking, one on independent work, and the rest appear to be "off-the-shelf" courses. There is little indication that technology would make inroads into the full degree program, that this represents a new area of concentration, and that there is a plan to support the teachers in their roles in the schools. Both the courses and the modes of delivery lacked innovation."

10. aligning priorities

Is the falling CS enrollment at your college or university a convincing argument for funding? Some PIs think so as the following show:

"The PIs assume that high school computer science is important for recruiting into the hard sciences and engineering in college. Since colleges have shown little appreciation for what preparation students have when they arrive, this course is designed to address those concerns. This probably is not the course to solve that concern."

"The project seeks to address a college problem, insufficient numbers of incoming computer science students, by training high school teachers in computer science. In doing so, they have lowered the general requirements and narrowed the focus of the teachers' preparation to serve the needs of college computer science. For example, in mathematics, the requirements have been lowered and essentials like discrete mathematics eliminated. Discrete mathematics is not difficult and is basic to understanding [stuff]. It also connects the computer models to the real world."

other concerns...

"There was no description of any involvement of the community. No mention was made of partners, teachers, etc. The panelists felt that there was no way this project could be considered systemic."

"Other concerns were that no recruitment or selection was described .."

"No mention was made of equity and no mention of recruiting females."

"...too often uses terms like encourage or might be."

"The project is not a significant change from the last project."

"The minority recruitment plan is multifaceted but does not include any direct contact with teachers or schools. Everything is done through mail ..."

"Too much of the follow-up is not described. The PI visits the sites and encourages interaction among participants. How? To do what?"

"No sample lesson plans were included in the proposal."

"No curriculum for the workshop was presented, only the topics and the high level goals. For example, in the first year it included 8 topics but the PIs gave no insight into how this would be carried out."

"Although the issues of involving and overcoming barriers for women and minorities have been addressed, it is not clear from where this expertise comes. Moreover, it appears that these will be topics discussed rather than concerns infused throughout the training."

other issues
languages are a tough sell...

Languages do not sell easily. Other, more transferable techniques, might...such as problem solving, modeling, computational science, etc.

C++ does lead to jobs, so why not consider ATE? Pascal had a root in structured (procedural) problem solving, C++ is an attempt to meet more practical computer science and employer needs. There is a conundrum here that has not been resolved.

Things to remember...

Teachers should be involved in every phase of the project, from planning to implementation to sustaining the project's impact.

Have a minimum of 100 contact hours, substantial follow-up, typically supported by 3-6 graduate credits or CEUs.

The efficacy of the courses is most easily established by graduate credit, but other methods may be OK also.

The evaluation must be deep and thorough. The impact should be on teaching practice and students.

Prove the project is self-sustaining.

Because of the use of prelims, panels generally see very good proposals so the competition is keen.

Ask yourself why Federal money should be spent supporting your need. The panel will ask that question.

Submitting a proposal is a humbling process, and the computer education community is not accustomed to this process. However, there are consistencies that make navigating the waters a bit easier. The experience over the past five years has produced some understandings about what could be fundable. Paying attention to what these panels have told us and the newest guidelines can improve your chances considerably. Submitting a prelim to NSF gives you an opportunity and a contact for extended conversations about the project you are proposing. It should improve your chances of not making a fatal proposal mistake.

From a talk delivered at the George Washington University workshop for future Principal Investigators in San Jose, CA, March 1, 1997 by

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