Special Feature

NSF Funded Projects: Perspectives of Project Leaders

Rodney L. Custer, Franzie Loepp, and G. Eugene Martin

The potential for significant grants for technology education in the United States has increased in recent years. In addition to state agencies, federal agencies such as NASA, the National Science Foundation (NSF)[1] and the United States Office of Education (USOE) have begun to fund technology education. Also, private foundations such as the Technical Foundation of America (TFA) and companies such as the AutoDesk Foundation have also issued requests for proposals (RFP) to enhance technology education. This momentum will no doubt continue.

The advocacy for a more technologically literate society is being championed by prestigious agencies, organizations, and associations. For example, the NSF and NASA have not only funded the development of *Technology for All Americans: A Rationale and Structure for the Study of Technology* (1996), but also the development of K-12 content standards for technology education which were released in April 2000. The National Academy of Sciences (NAS), the National Academy of Engineering (NAE), and the National Research Council (NRC) have launched initiatives to make the case for technological literacy for all Americans. Furthermore, the American Association for the Advancement of Science's *Benchmarks* (1993) and the NRC's National Science Education Standards (1996) both contain sections focused directly on technological literacy.

It is important to note that all of these agencies have been involved in the development of standards for technology education (International Technology Education Association, 2000). NASA and NSF have provided major financial support and the NAS, NAE and NRC have assembled committees to review the standards and make recommendations. It is therefore anticipated that the development of instructional materials and teacher enhancement programs will have funding priority now that the standards are published.

Should this prediction come to fruition, it is extremely important for leaders in technology education to proactively respond to requests for proposals. The record shows that a few technology educators, a few science educators, and a

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Rodney L. Custer (custer@indtech.it.ilstu.edu) and Franzie Loepp (loepp@indtech.it.ilstu.edu) are faculty with the Department of Industrial Technology, Illinois State University, Normal, IL. G. Eugene Martin is with the Department of Technology, Southwest Texas State University, San Marcos, TX.

few engineers have been responding to RFPs related to technology education. With the trend toward increased funding opportunities, it is imperative that this record be improved. Herein is the problem.

Statement of the Problem

The technology education profession in the U. S. is being presented with a significant opportunity to participate in NSF-funded programs. The presence of technology educators on the staff of NSF and the growing number of funded technology education-related proposals (including the ITEA's *Technology for All Americans* standards project) are among the factors that increased the visibility of technology education at the NSF. Increasingly, technology education is being valued at NSF, not only on its own merits, but for its promise for integrating content from across the disciplines and for helping mathematics and science educators deliver their content in an inquiry-based manner.

The opportunity exists for creative, energetic technology educators to develop instructional materials, enhance teachers, and conduct research. New program announcements will have opportunities for educating all teachers in science, mathematics and technology. And there will be more opportunities to do applied research. For example, an excellent research topic would be to determine the impact "design" has on student learning. More research needs to be done on the enhancement of teachers so as to promote student learning. To pursue these avenues of research, one might check the Division of Research, Evaluation and Communication at the NSF, which has a new emphasis on Research in Learning and Education (ROLE). For resources to develop K-12 curricula or to enhance teachers, contact the Elementary, Secondary, and Informal Education (ESIE) Division.

While the opportunities expand, the challenges also increase. For example, over the past decade, the number of faculty in technology education teacher education programs has declined. This is particularly true in research oriented programs, where grant proposal writing and publications are valued and rewarded in the tenure, promotion, and merit structures. Another problem is that the grant writing process for federal funding is extremely demanding and the standards are high. In order to achieve success in this arena, technology education faculty are being required to learn new skills and to expand their awareness of the potential for innovation and creative activities. Many faculty feel torn between launching into these creative new opportunities while, at the same time, meeting the escalating demands associated with shrinking numbers of faculty doing the work of the profession. Others worry that they lack the skills and background needed to compete successfully in federally funded program initiatives.

Moreover, faculty are also discovering that it is necessary to expand their range of contacts to collaborate with faculty from other academic areas if they are to succeed in the competitive grant writing arena. As a profession, technology educators are being encouraged to expand their circle of professional acquaintances beyond the profession to the larger educational community (particularly with science and mathematics educators). It takes considerable time

and effort to nurture these relationships and to develop mutual respect and trust. Often, these new alliances require serious and even painful rethinking of content, pedagogy, and political structures.

The technology education profession is at a critical juncture. The level of opportunity for participation in NSF and other funding agency possibilities has never been better. At the same time and for a variety of reasons, the level of participation and involvement of technology educators in these programs remains relatively low. A gap exists between a new openness to the profession (by the NSF) and technology educators' level of participation and inclination to respond. Who will fill this void?

Purpose and Research Objectives

The purpose of this study was to examine the perceptions and experiences of individuals who are currently being funded by the NSF to conduct a variety of technology education-related projects. These projects are of three major types: instructional materials development, teacher enhancement, and technician level program enhancement. The latter is focused primarily at the community college level. The study was conducted in the context of two Principal Investigator (PI) meetings, which were designed to facilitate the exchange of ideas and information among project leaders.

The objectives that provided focus for this study were to:

1. Explore perceptions of PIs regarding significant barriers and hurdles faced by those pursuing funding by the NSF for technology education-related programs,
2. Explore PIs' perceptions on a range of issues related to NSF program participation (e.g., problems in working with publishers, strategies for sustaining projects beyond funding, ways to overcome implementation barriers, addressing national standards, assessment challenges, etc.),
3. Obtain ideas and suggestions about how more professionals could be encouraged to participate in grant writing opportunities.

Methodology

At the 1998 International Technology Education Association (ITEA) conference, Drs. Dan Householder and Gerhard Salinger (NSF Program Officers) convened a group of approximately 20 principal investigators (PIs) of NSF funded projects to discuss common issues. The interest of the PIs in such a meeting was high and the meeting originally scheduled for two hours lasted four hours. After the meeting concluded, several PIs met to plan a strategy for obtaining funding and conducting a conference specifically for PIs whose NSF-funded projects related to technology education. Dr. Franzie Loepp of Illinois State University, conference organizer, coordinated the development of a proposal to plan and conduct the conference.

It was noted that PIs with projects in Advanced Technological Education (ATE)[2] and science and mathematics already held annual conferences. These conferences provided a model for the PI Conference for NSF Projects Related to Technology Education that was held in Washington, DC, on November 18 and

19, 1998. Because of the close relationship between technology education and ATE, it was decided to have the conference at the same location as the ATE PI Conference that was held immediately following the conference for technology education. An invitation was extended to all the technology education PIs to attend the ATE conference as well.

Sample and Procedures

The data for this study were gathered in conjunction with a formal evaluation of the PI conference, held in Washington, DC, in conjunction with the ATE conference. At the close of the conference, participants were provided an orientation to the research study and were formally asked to participate. Survey instruments were distributed to 37 PIs in attendance at the conference and verbal instructions were provided by the evaluator. Participants were asked to return their completed instruments within two weeks. Following this two-week period, follow up letters, a second copy of the instrument, and email messages were sent to non-respondents. After a second two-week response period, a second reminder was sent to remaining non-respondents. These procedures generated a total of 23 usable instruments, for a return of 62.2%.

Instrumentation

The instrumentation used in this study was a five-page, 18-question survey developed by the authors. It was comprised of three major sections. The first section requested demographic information such as type of program, number of previously funded NSF projects, number of proposals submitted to NSF, and so forth. The second section included six open-ended questions designed to explore the perceptions of PIs regarding issues such as barriers to participation, helpful suggestions and assistance received, advice to the NSF, etc. The third section was a series of questions using a five point, Likert-type rating scale with additional space for elaboration. This last section of the instrument was designed to probe the participants' perceived level of understanding of a variety of project related issues and topics (e.g., constructivism, inquiry-based curricula, standards, etc.).

The initial draft of the instrument was developed by the authors and was based on the objectives identified in the PI conference proposal submitted to the NSF and the objectives established for this study. The initial draft was then submitted to a panel of three experts who were intimately familiar with NSF-funded programs as well as program assessment issues. The panel critiqued the instrument and made suggestions for improvement. After the instrument was revised to address the panel's recommendations, it was resubmitted to the panel for a second review. Through this process, a number of substantiative changes were made to the instrument and all of the concerns and suggestions of the panelists were either incorporated into the instrument or resolved in consultation with individual panelists.

Data Tabulation Procedures

Two types of data were generated by the instrument. Responses to the Likert-type scale questions were tabulated and descriptive statistics (means and

standard deviations) were calculated. For the open-ended response questions, all raw data were entered into a database (Microsoftä Access). After the accuracy of these transcriptions had been determined, the authors independently analyzed the response set for conceptual themes for each survey question. These separate lists were developed and then they were compared, discussed, and merged into a single set of response themes. One set of response themes was developed for every open-ended question on the survey.

After the set of response themes was developed, the authors independently organized each response item into one of the response theme categories. This provided a mechanism for tabulating the frequency of identical (or closely related) responses. For example, one response theme generated for the "hurdles encountered when developing NSF proposals" question had to do with understanding and meeting NSF's expectations. Three individuals responded with comments indicating that this had been a significant hurdle in their experience with NSF. After the responses had been independently organized into themes, the categorizations were compared and differences were discussed and reconciled by the researchers.

To enhance the potential for the results of the conference to have depth and meaning, a qualitative component was added to the data collection process. One of the authors who is familiar with funded projects and a recognized process observer, served as rapporteur. His role was to actively listen to presentations and discussions throughout the conference and then make reflective comments during the last conference session. Following the conference, these comments and some additional reflective materials were formally submitted in written form to the conference organizer and the external evaluator.

Findings and Discussion

The first set of questions focused on the participants' perceptions of the kinds of experiences that had proved either beneficial or problematic as they pursued funding through NSF. It is important to note that the sample was comprised of those who have been funded by NSF. As such, their perceptions could differ from those who were not funded.

When participants were asked to identify the factors that had been most helpful to them throughout the process of writing a proposal and receiving funds from NSF, the single most important item was direct interaction and contact with NSF Program Officers (see Table 1). Most of the responses were even more detailed, extending appreciation to NSF program officers by name, for example. This is important information, because the perception persists that it may be inappropriate or even unwise to contact Program Officers. In reality, the NSF encourages interaction between potential grant writers and NSF personnel, because such interaction provides an opportunity to share and explore the viability of project ideas and strategies. It also provides a means for clarifying program guidelines.

Another mechanism for increasing the flow of communication between NSF and potential grant writers is through NSF's "rotator" program. Many of NSF Program Officers serve as rotators, typically for a period of 1-3 years. These

Table 1
Suggestions That Were Most Helpful in Obtaining Initial NSF Funding

Category	*f*
Interact with NSF Program Officer(s)	12
Write a clear, well-organized, direct proposal	4
Collaborate with successful PIs	4
Follow recommendations of reviewers	3
Obtain services of a qualified external evaluator	2
Review funded proposals	1
Review program guidelines carefully while writing proposal	1

individuals are usually faculty from colleges and universities, or come from funded research agencies or the private sector. Among the responsibilities of rotators (as well as full time NSF staff) while at NSF are constituting and conducting proposal review panel meetings, negotiating grants, conducting site visits, and interacting with grant writers. This practice of integrating temporary staff as active participants into the NSF decision-making process is valuable in several important ways. First, it provides a mechanism for better informing potential grant writers (i.e., rotators) about NSF guidelines, the processes used, and available funding opportunities. When they return to their home institutions, they are equipped to serve as valuable sources of information about NSF programs. The practice also serves to keep a steady flow of new ideas to NSF and to maintain contacts within the organization. In addition to new concept ideas, each new rotator comes to the position with colleagues and contacts who are qualified to serve on proposal review panels. They also know people who should be encouraged to write proposals.

Thus, interaction between potential grant writers and NSF is strongly encouraged and facilitated. Contacts typically include participation on grant review panels, phone calls and visits to NSF headquarters, and service at the NSF. This collaboration and interaction theme is further emphasized in the remaining categories presented in Table 1. In addition to interacting with program officers, respondents noted the value of collaborating with other successful PIs and following recommendations of reviewers.

Two of the items in Table 1 received only one response. One was the review of program guidelines and the other the review of successful project proposals. This was surprising to the authors since NSF considers familiarity with these documents to be important sources of information for successful grant writers. The results of this study indicate that this sample of successful grant writers found direct personal contact with knowledgeable individuals to be of more value than information obtained from NSF documents. While program guidelines are important and essential tools for communicating program information, assistance from persons experienced in reviewing, funding, and obtaining grants is needed in order to interpret the guidelines. Interpreting

program guidelines is frequently a daunting experience, particularly for those who are new to the grant writing experience.

The sample also identified some barriers encountered by the PIs during the grant writing process. This issue was addressed from two slightly different perspectives. First, the PIs identified the hurdles they had faced when developing their NSF proposal (see Table 2). From a slightly different perspective, they were also asked to discuss barriers that they believe discourage potential grant writers in areas related to technology education from submitting to NSF's programs (see Table 3).

Table 2
Hurdles encountered during proposal development

Category	*f*
Conceptualizing and visioning the project	8
Getting collaborators to follow through with commitments	4
Getting home institutions to accommodate needed changes	4
Developing the budget	4
Understanding NSF guidelines and expectations	4
No significant hurdles	4
Understanding and responding to reviewer comments	2

Table 3
Barriers that Discourage Technology Education-related Grant Writers from Developing NSF Proposals

Category	*f*
Lack of time to develop and implement grants	6
Lack of self-confidence with grant writing	5
Complexity of the guidelines and the process	5
Perception that competition will make funding unlikely	4
Obtaining good grant writing assistance	4
Lack of experience in grant writing	3
Lack of support with dissemination	1

The most frequently noted hurdle was conceptualizing and envisioning projects. This is an important point. Responding to program guidelines is much more complex than simply following straightforward formulas. Most NSF program guidelines are broadly written, systemically oriented, and designed to encourage creative approaches to complex problems. As such, the conceptual demands may be much greater than grant proposals written to agencies and organizations where the guidelines are more narrowly focused and prescriptive. A key recommendation frequently given to potential NSF grant writers is to begin with a good idea. If the idea is good, then it can be refined. As indicated previously, developing, testing, and refining project ideas is a creative and demanding process that requires collaboration, familiarity with numerous projects, understanding program guidelines, learning how to write good proposals, and more.

Management issues were a second type of hurdle identified. Specifically, grant writers noted the challenges associated with working with collaborators and personnel at their home institutions. These are real problems. The systemic nature of many NSF programs strongly encourages collaboration among and across institutions and programs. Through this process, partnerships and alliances are often forged among players who know relatively little about one another and who frequently are working together for the first time. The process is exacerbated by the fact that those actively involved in funded projects tend to be busy people, who are attempting to balance the demands of teaching and research with heavy workloads on multiple projects.

Collaboration is strongly encouraged and, in some cases, mandated by program guidelines, due to the potential for synergy and systemic impact. At the same time, it is also very important for potential collaborators to engage in the hard work needed to get to know what each person can contribute to the project, understand the constraints within which they will be working, and know the personal and professional characteristics (e.g., follow through, work style, reputation, expertise, etc.) of their potential collaborators. Individuals who tend to be most successful with collaborative relationships in funded projects are those who have been active with professional organizations and project work for long periods of time. They are well connected and have developed a network of contacts that can be engaged in work that is of mutual interest and which engages the expertise and imagination of everyone involved. Collaboration is critically important, but it also involves additional work and sound judgment.

The issues involved in working within the constraints of the variety of institutions within which researchers work can also be problematic. Institutions have different cultures and organizational structures. They follow different sets of rules and constraints. Some are academic while others are governmental or in the private sector. One of the hard realities of writing and implementing grants has to do with being able to forge an alignment among program guidelines, creative and innovative project ideas, and the unique (and often conflicting) regulations and constraints imposed by institutions. Bringing these into alignment is often one of the more frustrating challenges involved in project implementation. It is important to develop and maintain good working relationships with key officials with the institution. Experienced people who "know the ropes" are generally available within most institutions. They are of immense value when it comes to navigating the myriad of details and problems that can impede, or even ruin a project.

The participants also identified the difficulties associated with developing budgets and understanding program guidelines. Again, the importance of collaboration cannot be overstated. Often, those whose expertise is in conceptualizing projects, motivating partners, and providing leadership may know relatively little about budget detail. If funded projects are to be successful, it is essential that the expertise of many different people be engaged. This includes PIs, Program Officers, grant writers, budget officers, and others.

As noted earlier, this is a time of tremendous opportunity for the Technology Education community. NSF and other funding agencies are encouraging technology educators to respond to RFPs and to become actively

involved in grants and projects. At this juncture, however, the level of opportunity far exceeds the response from technology educators. One of the questions in this study focused on gaining some insight into this issue (see Table 3).

The barriers identified by the sample can be broadly classified as external (i.e., time, resources, assistance, etc.) and internal (i.e., self-confidence, concern with lack of experience, etc.). Those who are active with funded projects are quite familiar with both types of barriers.

External Barriers

The problem of time is real. In technology education, the numbers of teacher educators and teacher education institutions are shrinking. Some of the remaining programs are doing extremely well, with dramatic growth in enrollments, new faculty lines, and increased levels of funding. Other programs are working hard to build and rebuild programs. In both cases, time and energy demands on faculty are very heavy. For example, it is not uncommon for faculty to teach 3-4 courses per semester, while supervising student teachers, and attempting to pursue an active publishing and research agenda. Now that the *Standards for Technological Literacy: Content for the Study of Technology* has been published, there will be new opportunities (and expectations) for leadership in the curriculum development area.

Given these kinds of demands, unfortunately, many technology teacher educators are reluctant to pursue funded projects. The time and energy demands are perceived to be too great. Fortunately, colleges and universities also value external funding. In fact, pursuing external funding is increasingly becoming an integral part of the expectation of faculty across higher education. While time constraints are real, reward structures increasingly are encouraging grant writing involvement, with opportunities for being released from regular job duties, merit recognition, and salary increases. As technology educators, we are extremely fortunate that the escalating expectations for involvement in grant writing coincide with strong encouragement and opportunity from a variety of funding agencies.

Internal Barriers

Another barrier commonly experienced particularly by individuals new to grant writing is self-confidence. The perceived level of competition for grants, complexity of the program guidelines, and expertise of successful project leaders lead prospective grant writers to conclude that they are ill-equipped for the task. These are valid perceptions. Grant writing for NSF and other major funding agencies is highly competitive. It represents new and intimidating territory for many technology educators. However, most assuredly, these feelings are not unique to technology educators. Most new grant writers from all academic backgrounds and experience are not very confident about their ability to succeed. Even experienced grant writers struggle, often seriously, with the challenges associated with conceptualizing, writing, and implementing projects. Virtually no one is successful with every grant proposal. Those who are

successful are generally those who persist. Successful grant persons carefully attend to the reviews received from unsuccessful proposals. They demonstrate a willingness to reach out for support and assistance, and have the courage to try again, often repeatedly.

One issue that should be addressed in this context is the perception that funding agencies prefer to fund experienced people and that "first-timers" are at a disadvantage. There may be elements of truth in this perception since good grant proposal writing is an acquired skill and it is a function of experience. Those who have been successful are advantaged by having more and different kinds of contacts and experiences. Funding agencies also need to have confidence in the ability of project leaders to successfully implement ideas and manage the project. Thus, in this way, experienced grant writers do have some competitive advantage.

At the same time, we know from our experience with NSF and other funding agencies that there is strong interest in encouraging and equipping new participants to submit grants. Various mechanisms are used to provide assistance. Most programs require pre-proposals, which are brief concept papers that provide an opportunity to outline a project idea in a relatively brief format. Program officers (and in some cases, even full panels) provide feedback about the potential of project ideas as well as useful suggestions for how to best write a full proposal. As noted earlier, program officers routinely meet to discuss project ideas with potential grant writers and welcome opportunities to interact with a variety of people on project ideas. University research offices and successful PIs may serve as valuable resources for encouraging and providing assistance to faculty who are inexperienced with writing grants.

Technology educators should know that they are as equally well-equipped to participate in successful grant writing as are professionals from other academic areas. With the development of the *Standards for Technological Literacy* and their endorsement by the National Research Council and the National Academy of Engineering, there is strong interest at NSF and other funding agencies to increase the level of involvement of technology educators as key players in the broader educational enterprise. From this perspective, it could be argued that technology educators are in a period where they may hold a competitive advantage.

The concerns about experience are real barriers to participation. Problems with time, energy, and other resources are real also. In fact, one of the insightful observations made by the conference rapporteur, was that these challenges are not unique to new grant writers. "They exhibited varying levels of frustration, openly talking about their own insecurity and the future of their NSF projects" (Martin, 1998). But, these challenges can be overcome, and the assistance and rewards are there for those who are willing to engage and persist.

Participants were also asked to identify the benefits they had experienced as a result of working with NSF-funded projects. As can be seen in Table 4, the single most important factor was being able to engage in significant and meaningful work. Comments included, "the opportunity to make a difference in

education," "being an active participant in educational reform," and "chipping away at changing the ways in which we help students learn."

Table 4
Reasons to write NSF Proposals

Category	*f*
Provides the resources to do something significant	14
Brings recognition and credibility to institutions, programs and individuals	3
Promotes collaboration, organization, and support	2
Stimulates personal and professional growth	2
Curriculum development	1
Do not recommend NSF – too discipline specific	1

As noted in the methodology section, the data gathering process also included a qualitative component, whereby a rapporteur carefully observed the conference, interacted with the external evaluator to share observations and perceptions, and then formulated a set of observations. One key component of this report included a description of the characteristics of respondents, which are particularly pertinent to this discussion of why people choose to participate in funded projects. The observations of the rapporteur on successful NSF grant writers are:

1. They are quite cognizant of their sense of purpose as to why they originally applied for a NSF award and what they want to accomplish with their award. There are no gray areas in what they want to do and why they are doing it.
2. Through their NSF funded projects, they are very much interested in enriching the lives of others.
3. They are energetic to initiate their projects and carry them through to completion and they are excited about what they are doing and the impact they could have on students.
4. The ideas for their projects did not just happen by chance. The investigators are inquisitive about what they are personally doing with their research and what others are doing with their funded projects. They are deeply interested in knowing what others think about their efforts. They are caring individuals.
5. They are interested in sharing information about their projects. Sharing appears to occur from the moment the project is approved by NSF until the project is completed. Their sharing attitude comes about as a result of the recognition and value they place on the work and worth of others.
6. They are innovators and risk takers. They are willing to try what may at first seem like "silly" ideas to many and bring the ideas to fruition. Because they are innovators and risk takers, they probably tend to stand out among their peers. As risk takers, they are also futuristic. They are

willing to invest time and energy now for a better tomorrow. Thus, they are also patient and impatient.

7. They want to be part of and play a significant role in the synergy that is occurring in advancing the cause for technological literacy for all Americans.
8. As a result of the knowledge they have developed through their funded projects, they want recognition and this recognition appears to be in the form of being recognized by their peers as experts in their field of knowledge.
9. They are not complacent. Award winners want to make things happen and they want the things to happen now.
10. They are willing to accept failure in what they are doing. At the same time, failure becomes a challenge to try something new or in a different way.
11. They are a focused group. They are not obsessed with manipulative activities, student competitions, or positioning their disciplines. Instead, they are clearly focused on a better understanding of how students learn.
12. They openly discuss with self-confidence the relationships among math, science, and technology.
13. They are so confident in what they are doing that they have the audacity to believe that they can really make a difference. (Martin, 1998).

In summary, the benefits are clearly evident for professionals who possess or are able to develop certain kinds of characteristics. Among these characteristics are an ability to envision change and believe in the capacity for making a significant difference. They typically possess high energy, an ability to focus and sustain work over time, and an ability to collaborate successfully with many different people and constituencies. Individuals who possess these kinds of characteristics tend to be involved with funded projects. They are also the kinds of people who tend to experience the joys and benefits of that type of work.

Conclusions and Recommendations

As future funding topics are considered, the following may serve as food for thought for the generation of new and exciting projects.

1. The PI conference that was the basis for this study provided a means for sharing information and celebrating the successes of award winners. While this kind of interaction is valuable, it would be useful to find ways of extending this opportunity to a wider circle of professionals, including potential PIs. This would serve a valuable orientation/training function. It would also be a way of disseminating information about the kinds of excellent projects that are currently being funded. One idea would be to arrange for this type of conference at the major conferences of the math, science, and technology disciplines.
2. While the participants in this study were primarily teacher educators, it is important to remember that teachers and students are ultimately the primary stakeholders in the educational reform process. The NSF requires the involvement of elementary and/or secondary teachers in

Instructional Materials Development (IMD) and Advanced Technological Education (ATE) projects. Teacher enhancement should be directed at all levels within the technology education profession.

3. The "traditional" technology education population needs to expand the circle of groups and individuals with which it interacts and engages. The attendees at this conference provide ample evidence that technology education is much bigger than what the traditional community might think. The synergy generated across disciplinary boundaries should be encouraged.
4. Completed NSF projects need to be critiqued by objective and disinterested parties. Those projects that are deemed worthy should be disseminated to a larger audience as part of the annual grant program.
5. There was much discussion of the type of teachers needed to make change happen within the profession. Some of the presenters talked about the need for integrators while others identified the need for people who could manage chaos and who were facilitators. Much work needs to be done in identifying specific characteristics of teachers needed for the 21st century. Procedures also need to be developed for identifying, equipping, and encouraging individuals to respond to NSF and other grant writing opportunities.
6. A concerted effort should be made to monitor the requests for proposals distributed by the NSF (http://www.nsf.gov/), Department of Education (http://www.ed.gov/), NASA (http://www.nasa.gov/), and private foundations. Mechanisms should be developed to better disseminate this kind of information out to the technology education community.
7. The problem with low self-confidence in grant writing needs to be addressed. This can be done in a number of ways, including establishing mentoring relationships between successful PIs and high talent potential project leaders, encouraging participation at PI conferences and other grant-related information sharing and training activities, to name a few. On a larger scale, creative ways should be explored to build consortia whereby professionals can be encouraged to collaborate with others, build a creative vision, establish progressive goals, and foster sound strategies for proposal development.
8. Those interested in writing grant proposals should be encouraged to interact with program officers, PIs of funded projects, and other knowledgeable individuals.

Notes

[1]The National Science Foundation (NSF) is an independent agency of the U.S. Government with a mission "to promote the progress of science; the advancement of the national health, prosperity, and welfare; and to secure the national defense." NSF funds diverse projects, ranging from basic scientific research to a variety of educational initiatives. Additional information on the NSF and its programs can be found at http://www.nsf.gov.

[2]The focus of the ATE program is on enhancing the nation's "high tech" workforce at the two-year college level, particularly related to science, mathematics, engineering, and technology.

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