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ABSTRACT

The College Science Instrumentation Program (CSIP) was developed to provide seed money matching funds for the acquisition of laboratory instrumentation in order to improve the quality of undergraduate science/engineering education. This report describes the impact of the program and the program characteristics during the years 1985-87. An introduction provides background information about the number of grants awarded by the CSIP program, how the program evaluation was conducted, and the instrumentation used in the evaluation. Among grantees, 434 projects were sampled and 391 responded. Among unsuccessful applicants, 375 were sampled and 311 responded. Findings showed a 450 percent return on the CSIP investment and an increase of 130,000 square feet of laboratory space at grantee institutions. Three-fifths of the unsuccessful applicants reported that they obtained funding for equipment they had hoped to receive through CSIP funds. Further findings related to CSIP impact on students, faculty, departments, and institutions. The second part of the report describes CSIP program characteristics. The program attracted a total of 3,226 proposals from 811 undergraduate colleges and universities. Overall, 86 percent of the 1985-1987 grantees reported near or full implementation of the program. Program administration was considered fair by questionnaire respondents. Appendices include a list of CSIP site visit consultants and copies of the questionnaires sent to grantees and unsuccessful applicants. (Contains 41 tables/figures). (MDH)

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ASSESSMENT OF THE NATIONAL SCIENCE FOUNDATION'S 1985-87 COLLEGE SCIENCE INSTRUMENTATION PROGRAM

FINAL REPORT

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HIGHLIGHTS

- Evidence from both grantee-provided mail questionnaires and in-person visits to grantee institutions indicates that CSIP projects are affording students previously unavailable opportunities for direct, hands-on learning that significantly stimulate, enrich and enliven their undergraduate experiences. Many instances were found where CSIP-supported projects are thought to have produced increased department enrollments, increased student interest in science/technology careers, and increased post-college employment opportunities for students in science-related occupations.

- CSIP projects have consistently had substantial positive impacts on faculty and departments, both by providing a prestigious form of recognition of merit and -- more importantly -- by encouraging and enabling faculty to pursue their ideas for updating and improving undergraduate curricula. As well as often having beneficial effects on individual faculty member's careers, many CSIP projects have palpably reinvigorated faculty morale and enthusiasm for teaching.

- From the initial impetus provided by CSIP grants, many projects have attracted additional financial and other support enabling them to obtain additional instructional equipment and to grow in scope well beyond what had initially been contemplated. On average, CSIP projects attracted total financial support at least 4.5 times the size of the NSF grant amount. This often resulted in the allocation of additional laboratory space for undergraduate instruction, and in some cases led to the creation of new tenure-track faculty positions and new undergraduate degree programs.

- Site visits to a representative sample of funded CSIP projects found:

  - Most have generated educational and other impacts far in excess of what might have been expected from the modest financial investment represented by the CSIP grant; and

  - Most would not have been implemented, or would have been significantly scaled back, if the grant had not been received.

- The CSIP program appears to have had beneficial effects even among unsuccessful grant applicants, some of whom later went on to find other sources of financial support for the curriculum plans they developed in the course of the CSIP application process. However, most CSIP applicants who did not receive NSF grant support for their projects were not able to implement their ideas as fully as they had proposed, and more than a third have been unable to obtain any of the instrumentation their projects required.

- Women, minorities, and the handicapped were well represented among CSIP grantees, at levels above their representation in the current national population of scientists and engineers. Responsiveness to CSIP program objectives and persistence in submitting revised or new proposals if not initially funded were the only other proposal, investigator, department, or institution characteristics found statistically associated with success in winning CSIP grants. Grants appear to have been widely and equitably distributed across institutions and across science/engineering disciplines, in accord with program objectives.

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PREFACE

This report summarizes the findings and conclusions of an assessment of the first three years of the National Science Foundation's *College Science Instrumentation Program* (CSIP). In 1985-87, the period covered by this evaluation, CSIP awarded grants on a competitive basis to departments at a total of 410 non-doctorate-granting colleges and universities for the implementation of institution-based projects to improve undergraduate science/engineering instruction. Grants awarded under CSIP provided matching funds of up to $50,000 for the purchase of laboratory instrumentation for use in such projects.

In 1988, NSF awarded a contract to Westat, Inc. to conduct an independent assessment of CSIP during its first three years of operation and to develop recommendations to the Foundation regarding future modifications of the program. This intensive two-year study involved site visits to institutions with CSIP grants and statistical analyses of mailed questionnaire data from both successful and unsuccessful CSIP applicants. The extensive data assembled in the course of this study are summarized in this report.

As part of the assessment, an Advisory Panel was appointed to oversee the development of evaluation instruments and to ensure both the integrity of the review process and the validity of the study findings. An interpretive overview of the CSIP program and the results of the assessment has been prepared by the members of this Advisory Panel and is included as part of this report.

This material is based upon work supported by the National Science Foundation under NSF contract number CSI-8850357. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

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- Richard M. Berry, Program Director, Office of Studies and Program Assessment, SEE, NSF
- David H. Florio, Program Director, Office of Studies and Program Assessment, SEE, NSF
- Robert F. Watson, Director, Division of Undergraduate Science, Engineering, and Mathematics Education, SEE, NSF
- Duncan E. McBride, Program Director, Division of Undergraduate Science, Engineering, and Mathematics Education, SEE, NSF
- Alexander J. Barton, Program Director, Division of Undergraduate Science, Engineering, and Mathematics Education, SEE, NSF

Contractor staff and consultants who played significant roles in the preparation of this report were:

- Kenneth Burgdorf, Project Director
- Carin A. Celebuski, Assistant Project Director
- Thomas P. Ryan, Analyst
- Howard J. Hausman, Analyst

An expert Advisory Panel contributed to the survey design, the analysis plan, and the review of this report, and contributed an interpretive overview:

- Stuart B. Crampton, Department of Physics and Astronomy, Williams College
- Doris R. Helms, Associate Dean for Undergraduate Instruction, Clemson University
- Larry K. Monteith, Chancellor, North Carolina State University
- Suzanne W. Slayden, Department of Chemistry, George Mason University
- Thomas Tucker, Department of Mathematics, Colgate University
- David E. Wiley, Dean, School of Education and Social Policy, Northwestern University

From Westat, Katalina Measday was the data preparation supervisor, and Jonathan Feibus was the programmer. David Judkins was the project statistician.

We also acknowledge the indispensable contributions of the scientists and engineers who conducted site visits for the assessment (see Appendix A), and of the many officials, faculty, and staff members at the sampled institutions who cooperated during data collection.

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INTERPRETIVE OVERVIEW:

A Statement From the Assessment's Advisory Panel

Doris R. Helms (Principal Author), Associate Dean for Undergraduate Instruction, Clemson University
Stuart B. Crampton, Department of Physics and Astronomy, Williams College
Larry K. Monteith, Chancellor, North Carolina State University
Suzanne W. Slayden, Department of Chemistry, George Mason University
Thomas Tucker, Department of Mathematics, Colgate University
David E. Wiley, Dean, School of Education and Social Policy, Northwestern University

It would be difficult to imagine a project more successful than this one... All courses in the program were reviewed and revised; new equipment has been introduced in general courses to sophomores, and then used in ten other courses in the department as well as senior seminar and master's projects. Formerly, they showed slides and used data from books; now, they use labs and field work... The program, according to the dean, is now a "flagship"... and the department has been given a new tenure stream faculty position... The dean cited the program as an important factor in receiving a recent $100,000 state grant to interest inner-city youth in science.

- Dr. Thomas Tucker, Colgate University
  Site Visit Consultant & Advisory Panel Member

This project is doing extremely well. Apart from its direct impact on several courses and student research participation, it has had a catalyst effect on several other activities in the department...biology has created an impressive teaching/research environment for its majors. There is a definite upbeat feeling among the faculty... They are also generating an extraordinary number of students who continue on to do some graduate work in the field (25-30 per year) for a college with a total enrollment of 1,000.

- Dr. Norman Henderson, Oberlin College
  Site Visit Consultant

These statements by CSIP site visit consultants convey the essence of what has made the College Science Instrumentation Program[1] a success. Based on our own experiences, and on a thorough review of information compiled by Westat, the CSIP Advisory Panel enthusiastically endorses this NSF effort, and predicts that the extended impact of the CSIP program will be to rejuvenate undergraduate science, mathematics and engineering education.

Background

That science, mathematics, and engineering education in this country face profound difficulties is no longer in doubt. The problems and consequences are numerous and well documented. Some examples from *Science and Engineering Indicators:*

- Since 1983, the number of students interested in pursuing degrees in science and engineering (S/E) has steadily declined.
- Of 5.7 million college students presently enrolled, only 780,000 are preparing for S/E careers; only half of these will graduate with S/E degrees; and only 1% will continue to study for the Ph.D.

CSIP is an attempt to counteract these disturbing trends by supporting updating and revitalizing of undergraduate laboratory curricula in science, mathematics, and engineering. As such, it is part of a larger NSF effort to support and advance science education, the overarching goal of which is to encourage young people to become the scientists and engineerings of tomorrow, and to ensure that our future leaders in business, education, and government are scientifically literate and informed about technological issues affecting our national and global welfare.

Increased retention of undergraduates with S/E interests demands curriculum changes -- new ways to teach science that allow science to be experienced rather than learned from a book. According to recent

[1] The College Science Instrumentation Program (CSIP) was open only to non-doctorage-granting institutions from 1985-87. In 1988 the program was renamed the Instrumentation and Laboratory Improvement Program (ILI), and was opened also to two-year and doctorate-granting institutions.

findings from the National Assessment of Educational Progress (NAEP), creativity and curiosity must be emphasized through participatory classroom and laboratory activities if science proficiency and attitudes toward science are to improve.[3]

CSIP Program Overview

CSIP's fundamental premise is that laboratory work and field experience are at the heart of understanding how science works and what scientists do. Because modern instrumentation is a vital component of "doing" science, it is key to the changes we must make in science instruction.

For many colleges and universities, the last major expenditure of funds for undergraduate instructional science equipment occurred in the 1960's in response to the Sputnik challenge. Many college laboratories are now equipped with 30-year-old instruments that bear no operational resemblance to their modern counterparts, and which, in some cases, are unsafe. The problem of obsolescence has been exacerbated by an increased emphasis on research with less and less funding directed toward undergraduate instructional equipment. Small colleges have found it increasingly difficult to compete in the research market and, without available funds for instructional equipment, their greatest asset -- quality undergraduate educational experiences -- is being compromised.

Therefore, when NSF introduced the CSIP grant program in 1985, it focused on colleges with a primary mission of undergraduate instruction. CSIP offered these 2,706 non-doctorate-granting institutions an opportunity to acquire modern scientific instrumentation as part of the process of upgrading their science curricula. Proposals for CSIP grants were judged competitively. Awards were made for the purchase of scientific instrumentation, but the crucial factor in determining the merit of a proposal was the quality of the plan for <u>improving</u> instrument-based courses or curriculum. In all cases, investigators were required to demonstrate how requested instrumentation would be used to improve course work and student learning.

[3]Educational Testing Service. *The Science Report Card Elements of Risk and Recovery*. Princeton, NJ: ETS. 1988.

CSIP Impacts

Despite its modest scope during its first three years (1985-87), CSIP has been a very successful program, and has had a considerable positive impact, as documented in the Westat report. Although it is usually difficult to measure a program's effectiveness, especially when it purports to increase the quality of the learning experience or of education in general, we believe that the wealth of statistical data and written comments that Westat has analyzed with the help of the advisory panel provides clear evidence of wide ranging positive program impacts. Supporting the questionnaire data is evidence from the site visits, where a strong sense of excitement was felt by consultants who visited CSIP projects and witnessed the growth and improvement in programs and departments as a consequence of CSIP grants.

Unlike more expensive national programs that tend to cater to those already effectively competing, CSIP provided opportunities for small colleges, minority institutions, and college and universities that do not offer graduate degrees to develop new programs appropriate to local or regional settings, and to renew faculty interest in course development directly linked to student use of modern sophisticated equipment. As a result of CSIP funded programs:

1. Students' laboratory skills and critical thinking skills improved and the use of computers for interfacing, data collection and analysis increased. For example, awardees report:

    (Student) skills have improved with better tools. The opportunities afforded by the new equipment automatically enhance the opportunities for intellectual development... Motivation and attendance are both up.

    Since the level of the equipment used in training requires conceptual ability of the students, they are motivated to study and work harder, which in turn increases their skills, intellectual development and attendance. Student grades are climbing a bit more since their motivation and attitude toward the work load has improved.

    Impact on students appears substantial-excited, enthusiastic to work with research-level equipment, rather than just being told such equipment exists.

2. Enrollments in science courses increased.

The course is a product of innovative change within the department. The laboratory provides a hands on experience in molecular biology that has resulted in improved skills, increased numbers of independent study projects, enrollment in related courses is up, as are student presentations at national and regional meetings.

We are over-enrolled with a waiting list. Several using the advanced equipment have produced very good papers, and we have a strong flow of majors.

3. More students participated in undergraduate research. Evidence from principal investigators:

Almost all of our students are asking for opportunities to do undergraduate research.

...we now have a higher level of expectation and accomplishment in undergraduate research.

4. Students' familiarity with new laboratory technologies opened additional career opportunities in the sciences.

Students tell us the course has been valuable in helping them find good positions upon graduation. One student was hired primarily because she was the only candidate for a laboratory position who had some computer interfacing experience.

Anecdotal evidence suggests students now working in industry found experience on equipment helpful (especially to get job in first place).

5. Faculty experienced increased opportunities for self development, recognition and reward. Both faculty and departmental morale increased in turn. It was reported:

Access to this instrument has generated much pride and enthusiasm within the department as well as providing a state-of-the-art instrument for training undergraduates.

Our enthusiasm about the project proposal, getting the award, and putting the project in place has not diminished.

6. Equipment purchased for one purpose often became used in a variety of ways not originally anticipated, fostering even greater cooperation among faculty, interaction between upper level and introductory instructors and integration of courses from a variety of disciplines. From projects:

As other faculty have observed our integration of microcomputers into the classroom, they have become excited about possibilities for their courses.

We are integrating the equipment throughout the curriculum from freshman to senior level courses. Originally, the project was proposed for upper level courses.

Instruments purchased with these funds are being used in additional courses than originally proposed. They have had a greater impact than originally proposed.

7. It has revitalized undergraduate science instruction within the departments which have received grants, and the effects have often motivated changes in other science departments of the same colleges as well. Principal investigators report:

We've had indirect impact on the rest of our facilities in that the equipment purchased for the project showed its capabilities and provided the model for the upgrade of the rest of the labs.

The (project) is a model that has made a positive impact at all levels of the college. The curriculum interfaces with related disciplines and it has received full institutional support.

Because I wanted a forum to share my thoughts on this course, problems encountered and solved, I organized a state-wide symposium on Biotechnology, *which attracted faculty from most of the (state) system (both Biology and Chemistry departments represented). This has now evolved into a superb state-wide organization dealing with Biotechnology.*

8. The funds devoted to CSIP have been well spent and in many cases, have leveraged several fold. Some evidence from projects:

    ($10,300 grant) *This project allowed us to initiate our computer science lab. The lab has doubled in size last year (with $18,000 of additional equipment donations). Many, many new projects have started. We also have a continuing lab budget.*

    ($9,000 grant) *Our CSIP grant was evidence of program strength, and a contributor to space limitations involving laboratories. These factors were important in obtaining a $3.5 million grant from the (private) Foundation for a new physical science building.*

In addition, there is evidence that the act of preparing a CSIP proposal, even one ultimately not funded, has beneficial effects, because the planning process clearly revealed the direction a department should take to upgrade its program; in many cases, support was found outside CSIP for these proposals.

Future Steps

CSIP is clearly a unique program that gives dedicated undergraduate teachers the tools they need and the recognition they deserve as they strive to implement the innovations they think appropriate to their environments. We recommend the following:

1. Expand the CSIP program

Undergraduate science, mathematics and engineering education would benefit enormously if the CSIP program were to become available on a wider basis. Extending eligibility to doctorate-granting institutions and two year colleges as part of the ILI program has already expanded its scope by two and one-half times, but CSIP/ILI should be funded and expanded further. Generalizing from the results found for CSIP, the doctorate-granting institutions should benefit as much as the type of schools supported by CSIP in 1985-1987.

2. Maintain interest in small undergraduate institutions

Many of the impacts on institutions reported in the CSIP evaluation were related to the character of these schools. A large proportion of the CSIP grantee institutions were very small schools that never received grants for scientific purposes -- particularly from the highly prestigious National Science Foundation. The impact in such small communities tends to reverberate at all levels, much more so than at larger and scientifically more sophisticated institutions. Since these small schools are a major source of students who pursue Ph.D.'s in the sciences, further expansion should not overlook the small undergraduate institutions with limited resources.

3. Increase funding for introductory courses

In most institutions, for a variety of reasons, introductory laboratory classes are often the last to be given resources and attention. Increased expansion and funding would allow for maximum impact at the introductory level. Large classes require many duplicate pieces of equipment, and because the equipment is used solely for teaching it is difficult to obtain through available funding sources.

4. Maintain funding for upper-level courses and for undergraduate research

Student participation in upper-level courses is also critical, as is active participation in research at this level. Student research is one of the best mechanisms for "doing" science, and students in these programs serve as models for others. It is also imperative that upper level or research faculty work with those teaching lower level courses. CSIP is a medium for this exchange as both groups become involved in curriculum change and renewed efforts to assess student learning.

5. Increase funding for courses that serve general education students and promote science literacy

If the program were to be expanded, large numbers of general education students in our colleges and universities would also be exposed to improved laboratory facilities where they could experiment and "do science" rather than just read about it. If we are to have a scientifically literate public, such opportunities must be made available. CSIP/ILI can do this if its scope and funding are increased.

6. **Increase networking and dissemination efforts**

Products of successful programs should be disseminated and networking of successful grantees with others should be undertaken immediately. The enthusiastic response to the CSIP program indicates that there is genuine interest among science faculty in the program goals. Now that many projects have been developed successfully, the value of the program could be greatly increased by disseminating descriptions of successful programs to others who seek to accomplish similar objectives in the most cost-effective manner. A modest investment in the necessary expansion of NSF staff for this purpose would be justified.

.....

Our future as a nation depends on turning the tides of science, mathematics and engineering education. CSIP/ILI is a successful model which has proven that this can be done by providing up-to-date equipment for state of the art demonstrations and experiments that pique the students' curiosity and allow for hands-on problem solving in the true "spirit" of science.

The College Science Instrumentation Program (CSIP) was developed by the National Science Foundation's Office of Undergraduate Science, Engineering and Mathematics Education (USEME) as a vehicle to provide seed money matching funds for the acquisition of laboratory instrumentation in projects to improve the quality of undergraduate science/engineering education. In its first three years of operation, 1985-87, the CSIP program awarded 780 competitive grants in the $5,000 to $50,000 range (totalling $19.7 million) for proposed curriculum improvement projects at non-doctorate-granting undergraduate institutions. Since then, the program has been expanded and renamed the Instrumentation and Laboratory Improvement (ILI) program. The expanded program is currently open to all two-year and four-year colleges and universities, both doctorate-granting and non-doctorate-granting, and it now awards grants of up to $100,000.

This report is a wide-ranging, independent evaluation of the first three years of the CSIP/ILI program. The findings apply <u>only</u> to the kinds of institutions and grants that were involved at that time.

The evaluation was conducted by Westat, Inc., under contract to NSF. In November 1988, evaluation study questionnaires were mailed to all 234 grantees in the 1985 CSIP and to samples of 100 grantees each in the 1986 and 1987 programs. In addition, samples of 125 unsuccessful CSIP applicants were selected in each of the first three program years, and they too were sent questionnaires asking about their experience in the program. Lastly, postsurvey site visits were made to a randomly selected subsample of 49 grantees to validate the questionnaire data and collect additional information about project development and impacts.

All findings are in the form of program-wide estimates and are based on response rates of 90 percent for grantees, 82 percent for unsuccessful applicants, and 100 percent for projects that were sampled for site visits.

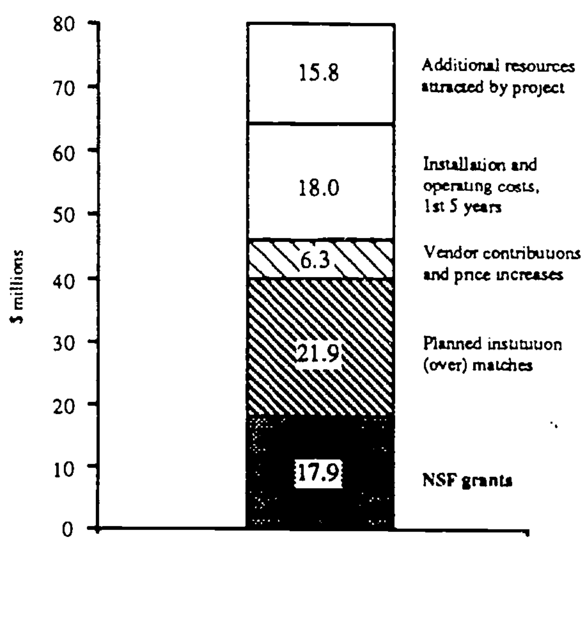
Findings

Resource Development

The CSIP program provided "seed money" intended to stimulate the upgrading and expansion of science/engineering instructional programs and resources at recipient institutions. One indirect indicator of program success is the amount of additional laboratory space that was created to house CSIP-generated programs and equipment. About one-quarter of the grantees (26 percent) reported that they received additional laboratory space as a result of their CSIP projects. The amount of additional space averaged 640 square feet per affected project and was 130,000 square feet in total.

Another quantitative indicator is the financial return on NSF's investment: the total dollar size of the projects that ultimately germinated from the CSIP seed money. If all grantee institutions honored their commitments to provide the equipment matching funds promised in their proposals, the total dollar amount of equipment in CSIP projects should be somewhat more than twice the amount of the CSIP grants. In fact, the projects spawned by CSIP were considerably larger than that in most cases (Figure 1).

Figure 1.-- Financial composition of projects generated by CSIP



Overall, CSIP grants to the approximately 760 grantees represented in the survey data totalled \$17.9 million, an average of \$23,500 per award. When institution matches, and overmatches, unanticipated vendor contributions and price increases, installation costs and estimated operating/maintenance costs over the first five years of the project are added in, along with additional resources and equipment subsequently attracted by the project, the aggregate project size increases to \$80 million, or an average of \$105,000 in equipment and expenses per project. This represents a return of about 450 percent on NSF's investment. This is an extremely conservative estimate, however, for four major reasons.

First and most important, the return on investment calculation does not include any valuation of the time spent by principal investigators (PIs) and other CSIP project staff in the development of the upgraded/expanded curricula in which the project-supported equipment was used. The PIs reported spending an average of 337 hours (42 8-hour days) apiece in CSIP project implementation activities, of which nearly half was spent specifically in curriculum development.

Second, the reported 450 percent return on investment does not include any valuation of the 130,000 square feet of additional undergraduate laboratory space created to house CSIP-generated projects.

Third, the report documents many instances where grantees vastly understated the extent of additional resources that were attracted to their departments and institutions as a result of their CSIP projects. For many of the small, teaching-oriented undergraduate institutions served by CSIP, the NSF grant was an important form of national recognition of their program, a certification of excellence that was valued in its own right and that also proved valuable in attracting additional funding support to the program from within the institution, from private foundations, from local industry, etc. Many examples of such resource leveraging were found, going far beyond the \$15.8 million that was reported.

Fourth, the return on investment calculation does not include the energizing, stimulating effect the CSIP program had upon those who applied for but did not receive CSIP grants. About three-fifths of these unsuccessful applicants reported that they were subsequently able to obtain funding support for at least some of the equipment they had hoped to get through CSIP, whether by using the matching funds their institutions had already agreed to commit or by finding other sources of funding support. The total amount of this additional instructional equipment indirectly generated by CSIP is estimated to be about \$27 million.

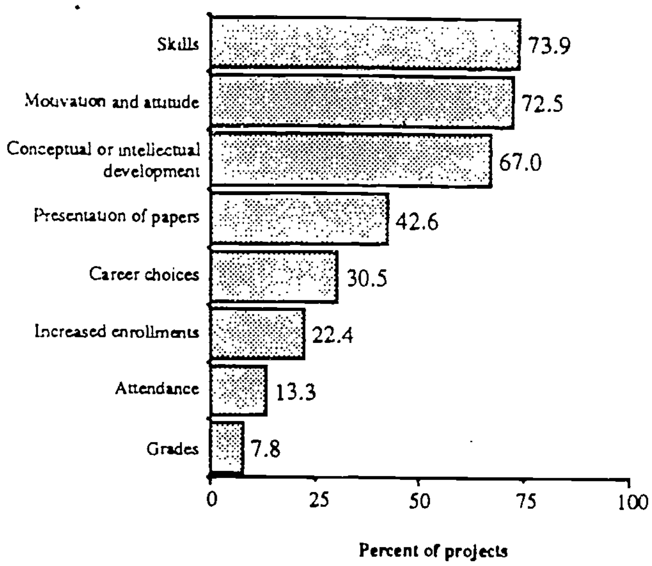
In view of these considerations, it seems likely that the real multiplier effect of the CSIP program in generating improved instructional equipment and resources in undergraduate science education, beyond what could be purchased with the modest amounts actually invested by NSF, is much greater than 450 percent. Indeed, it is probably somewhere in the 700-900 percent range overall. For many individual cases documented in this evaluation, the multiplier effect was even greater than that.

Impacts on Students, Faculty, and Institutions

Among projects that were mostly or fully operational with students at the time of the evaluation, most were reported to be having significant educational impacts (Figure 2). Project-provided opportunities for students to have hands-on experience in understanding and working with advanced scientific equipment were frequently cited as contributing to observable improvements in students' skills (74 percent of projects), motivation and attitude toward coursework (73 percent), and conceptual and intellectual development in the subjects affected (67 percent). Nearly half of the projects had already led to the development and presentation of student papers using CSIP-funded equipment (43 percent), and almost a third claimed to have influenced students to select careers in science/engineering (30 percent).

The reported impacts on scientific and engineering pipeline factors -- presentations, careers, enrollments -- was lower. However, given the brief duration of most projects at the time of the survey and the time lag inherent in pipeline effects, this should not be surprising.

Figure 2.-- Percent of CSIP projects with positive impacts on students in various areas



The findings from an extensive series of post-survey site visits generally confirmed these PI-based claims of significant educational impacts. Insofar as the site visit teams disputed the PI-provided assessments, the complaint was usually that the PIs' questionnaire responses had understated the educational impacts of the projects.

Two other areas where both the PIs and the site visit teams agreed that CSIP projects were consistently having strong positive impacts were:

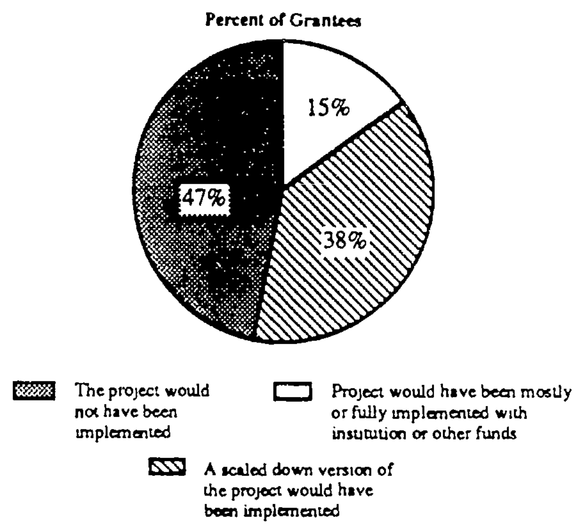
- Improved morale of department faculty, including the PI (71 percent of operational projects, according to the site visitors); and

- Increased prestige of the recipient department within the institution (88 percent of projects).

In the areas of faculty morale and department prestige, the value of the CSIP grant as an all-too-rare expression of national recognition and encouragement of excellence in undergraduate education may often have been as important as the intrinsic educational value of the equipment and curriculum changes the grant funded.

One important question addressed by the evaluation site visit teams in interviews with PIs, department heads, and others was whether the grantee's project would have been able to go forward in the absense of CSIP. The site visitors' answer, in most cases, was "no," at least not with the size and impact it achieved through CSIP (Figure 3). Only an estimated 15 percent of CSIP-funded projects would have been mostly or fully implemented with other funds, had the CSIP grant not been received. This suggests that it was not just a matter of CSIP aligning itself with meritorious projects that were destined for success, with or without the program. In most cases, it was the judgment of the PI and the independent evaluators that the CSIP program itself was instrumental in the creation and actualization of the project.

Figure 3.-- Site visit assessment of whether projects would have occurred without CSIP



Program Reach

In its first three years of operation, the CSIP program attracted a total of 3,226 proposals from 2,449 different principal investigators (PIs) representing 811 undergraduate colleges and universities. The program awarded a total of 780 grants to 762 different PIs from 410 different institutions during this period. The awards totalled $19.7 million and averaged $25,224 per project, which is about the middle of the $5,000 to $50,000 applicable range during his period.[4]

Awards were distributed across fields in proportion to the number of proposals received. Disciplines with the heaviest representation were chemistry (27 percent of the awards), biology (21 percent), engineering (12 percent), and physics/astronomy (12 percent). The six remaining discipline categories (computer science, earth science, mathematics, psychology, social sciences, and interdisciplinary) each received under 10 percent of the total awards.

Half of all awards were for projects that would affect both upper division and lower division undergraduates. Most of the rest (45 percent of the total) were targeted only for upper division students.

Most grantees proposed to address more than one of CSIP's four program objectives:

- 95 percent sought "introduction of modern instruments to improve the experience of undergraduate students in S/E courses, laboratories, and field work";
- 58 percent involved "interfacing of computers with scientific instrumentation and other appropriate uses of current technology in S/E instruction";
- 59 percent entailed "development of new ways of using instrumentation to extend instructional capabilities"; and
- 6 percent proposed the "establishment of equipment sharing capability via consortia or centers."

Project Development and Implementation

Grantee projects in all three program years were generally further along than had been expected when the evaluation began. Overall, 86 percent of the 1985-87 grantees reported that they were mostly or fully operational; this included 98 percent of the 1985 grantees, 88 percent of the 1986 grantees, and 78 percent of the 1987 grantees. In the same vein, over three-fourths of all grantees reported that their projects were on schedule or ahead of schedule. Almost all grantees (98 percent) reported that the equipment they purchased was the same as, or functionally equivalent to, the equipment they originally proposed to acquire. Validation data from the site visits support these claims.

This is not to say that grantees have not had any problems implementing their projects. On the contrary, almost half (44 percent) of all grantees encountered significant problems of one kind or another as they sought to develop their CSIP projects. As reported by 20 percent of the grantees, the most common problem was that their projects were delayed by unexpected difficulties in acquiring, installing or learning to use their equipment. Problems in financing or in arranging adequate maintenance for the equipment were reported by 12 percent of all grantees.

Additionally, many grantees (40 percent) reported that project setup activities took significantly more time than they had expected. These activities required an average (mean) of 336 hours per grantees or over 40 person-days of time-on-task work. Few grantees (19 percent) received any release time for this work.

In view of the magnitude of the problems and challenges encountered by grantees, the large amounts of time typically required for project setup, and the fact that NSF has not closely monitored grant progress, CSIP grantees as a group have demonstrated remarkable resolve, resourcefulness, and conscientiousness in doing what needed to be done to overcome obstacles and adhere to their proposed project schedules and specifications.

Program Administration

From all indications, the 1985-87 CSIP program was administered in an extraordinarily scrupulous and fair-minded manner. Grants were distributed widely among institutions; they were distributed among disciplines in proportion to the number of proposal

[4] In the case of PIs who received multiple CSIP awards in the 1985-87 period, the evaluation study covered only the first award.

received; and the only individual or institution characteristic that was predictive of success in winning CSIP awards was persistence in applying more than once.

Grantees and unsuccessful applicants alike had few criticisms of the way the program has been administered by NSF. Some complaints were made about the timing and distribution of the program announcements, about the (too short) deadline for proposal submission, and about the clarity of the program guidelines. Even among unsuccessful applicants, however, such complaints were infrequent (all involved fewer than 30 percent of unsuccessful applicants and fewer than 20 percent of grantees).

The one area where complaints were common was "clarity of feedback from proposal review," which was identified by half of all unsuccessful applicants (51 percent) as an aspect of the program needing improvement. Judging from the comments accompanying this response, clarity per se was not really the issue in many cases. Many of the unsuccessful applicants had invested considerable effort and hope (and, sometimes, personal prestige within their departments and institutions) in the preparation of their proposals, and some of them took the proposal rejection letter and accompanying critical feedback from NSF as a more general rejection of themselves personally, of the quality of their department's teaching program, or even of the quality of their institution. This propensity is something NSF should be aware of and extremely sensitive about in the future.

Conclusions

In its first three years, the CSIP program was remarkably successful, demonstrably revitalizing and enriching the instructional programs at many recipient institutions and producing a high return on NSF's financial investment. The very modest investments represented by most CSIP grants during this period often had remarkable impacts on recipient departments and institutions, impacts that sometimes seemed far out of proportion to the size of the grant. It was not uncommon for new courses, new laboratories, even new degree programs to be created as a result of $10,000 or $20,000 CSIP grants. The site visit teams often saw evidence of genuine revitalization of teaching programs and renewed enthusiasm of faculty, as well of increased student interest and involvment in the curriculum. In addition to these educational impacts, the existence of the NSF grant often attracted additional interest to recipient programs -- and additional funding support -- from within the institution and also from outside sources.

In trying to account for the seemingly outsized, disproportionate impacts documented in this assessment, several factors appear to have been at work:

- Most CSIP-funded projects were highly meritorious (needed, worthwhile) and were conscientiously, competently administered by PIs eager at the chance to put their ideas for curriculum improvement into effect;

- CSIP was one of very few Federal programs that recognize and reward excellence in undergraduate science teaching in a meaningful way, which made the recognition especially salient and significant at many institutions;

- Faculty and departments at the undergraduate (non-doctorate-granting) institutions that were the focus of CSIP during the 1985-87 period have comparatively few opportunities for external recognition or support of any kind, not just in the area of teaching; most are not actively involved in grant-supported research, and some have not had any Federal research grants for years; and

- Partly because the faculty and departments at these institutions do not have access to grant-funded research equipment (which could be used partly for teaching or could be converted to instructional use when no longer needed for research), it is especially difficult for them to keep their instructional equipment reasonably up to date.

The combination of these four factors may account, in part, for the impressive impacts of the CSIP grant program at non-doctorate-granting undergraduate institutions. Now that the CSIP/ILI program has been expanded to include doctorate-granting and two-year institutions, it will be interesting to see whether the kinds of program impacts that occurred during the first three years of the program will also be manifest in these other types of settings.

Background

The College Science Instrumentation Program (CSIP) was developed by the National Science Foundation (NSF) in response to problems predominantly undergraduate schools were having keeping pace with current developments in the sciences. Specifically, the lack of adequate funds to purchase up-to-date laboratory equipment kept many from initiating significant curriculum improvements. In a competitive grant program begun in 1985, CSIP awarded matching equipment grants to schools with plans to improve undergraduate science instruction. Requests for CSIP equipment funds were evaluated by NSF on the basis of the curriculum development plans proposed.

The CSIP program promoted the long-term goals of NSF and the scientific community of increasing the number of undergraduates who choose science as a career, and enhancing the preparation of these students. Primary objectives of the program were to support:

- The introduction of modern instruments to improve the experiences of undergraduate students in science and engineering courses, laboratories, and field work;
- The interfacing of computers with scientific instrumentation and other appropriate uses of current technology in science and engineering instruction;
- The development of new ways of using instrumentation to extend instructional capabilities; and
- The establishment of equipment sharing capability via consortia or centers.

Additional objectives of the program were to support:

- Projects that set standards for instrumentation and its use against which other institutions measure themselves and which they strive to achieve; and
- Products such as laboratory manuals and other scholarly publications serving a common goal as well as local improvement.

In addition to its focus on enhancing the experiences of science majors in instructional settings, the CSIP program was also intended to impact other student populations. Target groups include students interested in undergraduate student research, non-science majors, students training to become precollege science and mathematics teachers, and women, minorities, the physically disabled, and other groups traditionally underrepresented in science and engineering careers.

The Dimensions of the CSIP Program

In its first three years of operation, the CSIP program awarded 780 grants to 410 different institutions (out of a total of 2,706 non-doctorate-granting colleges and universities eligible to participate). A total of $19.7 million was awarded in those three years for the purchase of laboratory equipment, with individual grants ranging from $5,000 to $50,000.[5] Table I-1 shows the number of proposals received in each year, the number granted, and the ratio of awards to proposals received.

Table I-1. CSIP proposals by grant year: 1985-87

Proposals	Grant year			
	Total	1985	1986	1987
Proposals received	3,226	1,335	922	969
Grants awarded	780	234	211	335
Award rate..................	24 %	18 %	23 %	35 %

Source: Assessment of the 1985-87 College Science Instrumentation Program, Office of Studies and Program Assessment, NSF, 1990

The number of proposals submitted to NSF in 1986 and 1987 leveled off in the 900s after the initial wave of 1,335 received in 1985. Increased funding for the 1987 grant year permitted a greater number of awards in that year than in the two previous years. Together, these factors resulted in increasing success rates for applicants over time.

As shown in Table I-2, 30 percent of the 2,706 eligible schools submitted a CSIP proposal in at least one of the program's first three years. Over time, from a first-year high of almost 25 percent, the

[5]The CSIP program has since been expanded and renamed the Instrumentation and Laboratory Improvement (ILI) program. The expanded program is open to a wider range of undergraduate institutions, and the grant ceiling is now $100,000.

proportion submitting dropped to about 18 percent in both 1986 and 1987. The overall success rate for schools submitting at least one proposal during that time was over 50 percent.

Table I-2 Rates of CSIP participation and success for eligible institutions by grant year. 1985-87

Index	Grant year			
	Total	1985	1986	1987
Percent of the 2.706 eligible schools submitting one or more CSIP proposals ..	30 0	24 8	18.8	18.3
Of schools submitting proposals. percent with one or more funded.	50 6	28 4	34.8	47.4

Source. Assessment of the 1985-87 College Science Instrumentation Program, Office of Studies and Program Assessment, NSF. 1990

Assessment of the Effectiveness of the CSIP Program

In March 1988, NSF awarded a contract to Westat, Inc., of Rockville, Maryland, to assess the effectiveness of the CSIP program during its first three years of operation. This report presents the principal findings based on data collected through mail questionnaires completed by CSIP grantees and unsuccessful applicants, and site visits to CSIP projects. All reported data are weighted to represent the CSIP universe. This report is organized around two broad topic areas:

- CSIP program impacts (Chapters 1-4); and
- CSIP program characteristics (Chapters 5-7).

For those interested in further breakouts of the questionnaire data, a report entitled "Detailed Statistical Tables" is available from NSF. For more information on sampling and data collection procedures, a third volume, entitled "Technical Report," is available.

Assessment Advisory Panel

An Assessment Advisory Panel, composed of six academic scientists and engineers familiar with the CSIP program, was appointed to provide technical oversight and assistance in the design of the assessment and the development of the questionnaires and in the interpretation and presentation of the findings. The Panel was also asked to review the assessment findings and to write the interpretive overview of the CSIP program that appears at the front of this report. Members of the Panel are identified in the Acknowledgments section of this report.

Data Sources

Data for this assessment of the CSIP program were collected through mail questionnaires addressed to principal investigators (PIs) of funded CSIP projects, and to proposed PIs of unfunded projects. Additional data were obtained through site visits to a subsample of operating projects. Copies of the grantee and unsuccessful applicant questionnaires appear in Appendix B, as does the site visit summary form.

Sampling for the mail questionnaires was designed to achieve adequate representation by year, field of science, the success and participation rate of the submitting institution, and whether the proposed PI is a new or a previous applicant.

Among grantees, 434 projects were sampled, and PIs from 391 responded, resulting in a response rate of over 90 percent. Among unsuccessful applicants, 375 were sampled and 311 responded, for a response rate of 83 percent. Site visits were made by two-person teams to a subsample of 49 CSIP projects. The current PI, other faculty, and administrative figures were interviewed Information obtained was used to complete site visit summary forms, which distilled the information into a quantitatively manageable form.

PART 1

PROGRAM IMPACTS

CSIP PROJECT RESOURCE DEVELOPMENT

Highlights

This chapter describes the extent to which projects have leveraged resources beyond the original grant award. Data presented are from the grantee questionnaire and represent PI-provided information about their projects.

In the 1985-87 period, CSIP grants averaged $23,500. The program required a one-to-one match from institutions, but the assessment found that most projects leveraged substantially more resources than this. In fact, when institution matches, overmatches, and implementation costs were added to vendor donations, and additional resources and equipment subsequently obtained, the average project value rose to $105,000--a return-on-investment of about 450 percent for the CSIP program. This measured return, impressive by any standard, is a minimum estimate. It does not include any valuation for the 130,000 square feet of additional space generated by CSIP projects, the 337 hours of labor required, on average, to get projects off the ground, or any correction for what appears to have been significant underreporting by grantees of the additional resources their grants have helped leverage.

Above-Match Resources Obtained

CSIP grantees were required to match the amount of their NSF grant with instrumentation funding from other sources. Most projects obtained financial support well beyond this minimum level, leveraging additional resources by way of substantial overmatches, discounts, upgrades, and equipment donations (Table 1-1). NSF contributed an estimated $18 million over the 3 years covered in this assessment,[1] for an average of about $23,500 per project. Matching funds for these projects total over $22 million, or $28,800 per project: an average overmatch of $3,300. Furthermore, over a third of the projects (35%) received more support from their equipment vendors than had been planned in the CSIP proposal. These vendor contributions totalled an estimated $5 million over and above whatever discounts had been negotiated when the proposal was submitted. Often, especially when changes in equipment prices or offerings occurred between the proposal and the award, vendors helped by providing deep discounts so the PI would be able to obtain the originally planned equipment at the earlier (now obsolete) price or by providing an upgraded model at no extra charge. Also, it was not uncommon for PIs to persuade vendors to donate additional equipment, over and above what had been agreed, once NSF had certified (by virtue of its grant) that the PI's project was indeed meritorious.

Such vendor contributions did not always occur, however. For 21 percent of the projects, it was necessary for the institution to spend more money than had been planned to acquire the basic project equipment. These unanticipated additional costs, which usually reflected vendor price increases since the proposal, totalled over $1.3 million, for an average of $8,300 per affected project. Because they were unanticipated, and unbudgeted, these additional costs often represented a significant hardship for the institution.

Cumulatively, these sources contributed a total of over $46 million of what could be considered base equipment for CSIP projects, amounting to more than 2.5 times the NSF investment.

Costs of Project Implementation

For most CSIP grantees, project implementation required expenditures that could not be covered by the NSF contribution or matching funds. Ninety percent of projects required such additional funds for necessities such as facility renovation and equipment installation, supplies, utilities, equipment maintenance, and salaries for work related to installation and maintenance of the equipment. The projects that reported expenses in these areas are estimated to spend $18 million, or an average of $26,200 per project, for project implementation over the first five years of operation. Like the unanticipated price increases discussed above, some institutions did not fully anticipate project operating

[1] This and other totals reported in this chapter slightly underestimate true program amounts as a result of the unduplication procedure used in this evaluation. There were 19 grantees during the 1985-87 period who received more than one CSIP award. They were surveyed only once, with reference to their first award, and consequently the second award is not represented in the survey findings. Additionally, 2 of the 762 grantees who <u>are</u> represented submitted questionnaires that did not disclose the requested financial information. They, too, are not included in the Table 1-1 estimates.

Table 1-1. Principal investigator's report of cost components for CSIP projects: 1985-87

Project cost component	Projects affected		Dollar amount (in thousands)	
	Number	Percent	Total	Mean
Equipment for base project				
Total	760 *	100	46,114	60.7
NSF contribution (CSIP grant)	760	100	17,874	23.5
Required match and planned overmatch	760	100	21,917	28.8
From institution	714	94	17,820	24.9
From other source	158	21	4,098	25.9
Other overmatch				
Total	372	49	6,323	17.0
Additional cost for base equipment (e.g., due to price increase since proposal)	157	21	1,307	8.3
Vendor contribution				
Total	268	35	5,017	18.7
Deep discounts on price	185	24	3,282	17.8
Upgrades	76	10	345	4.6
Other (e.g., additional equipment)	50	7	1,389	27.5
Installation and operating costs, first 5 years				
Total	688	91	18,019	26.2
Renovation and installation	361	48	2,630	7.3
Annual maintenance (x 5)	458	60	5,751	12.6
Annual supplies and utilities (x 5)	586	77	2,892	4.9
Pro-rated salaries (technicians, students, faculty, release time) for equipment maintenance and operation (x 5)	210	28	6,746	32.1
Other resources attracted as result of grant				
Total	292	38	15,845	54.3
Additional equipment	242	32	9,830	40.6
Other resources	100	13	6,015	60.2
All reported components				
Total amount	760	100	79,978	105.2
Return on NSF investment (total divided by NSF contribution)			447 %	

*Estimates are based on 760 of the 781 projects funded in 1985-87, which account for $17.9 million of the $19.7 million awarded during this period. For individuals with multiple awards, only the first one is counted.

Source: Assessment of the 1985-87 College Science Instrumentation Program, Office of Studies and Program Assessment, NSF, 1990.

costs when they submitted their CSIP proposals, and that oversight sometimes presented real hardships for them.

Additional Resources Attracted by the Grant

While unanticipated price increases and operating expenses sometimes presented unexpected hardships for institutions, many projects also produced unexpected benefits of substantial magnitude. The seed money provided by CSIP often attracted additional resources that expanded projects well beyond their originally conceived scope and created additional capabilities for departments and institutions. Such expansions, totalling $15.8 million in additional resources, were reported by 38 percent of the 1985-87 projects.

The following are examples of the kinds of snowball-like "multiplier effects" reported by grantees as having occurred once they received their CSIP grants. The statements, provided by the PIs, are preceded by parenthetical notations of the size of the NSF grant.

- ($9,000 grant) *The institution, since the CSIP award, has upgraded all microscopy, including electron microscopy. Over the past 3 years, that amount is about $200,000.*

- ($6,700 grant) *{corporation} gave $20,000, {local} Foundation gave $30,000, {local} Consortium of Higher Education gave $14,000, for computers, video development, and workshop funds.*

- ($44,500 grant) *We received {$160,000} funding from the {private} Foundation for FT-NMR and GC-MS subsequent to our CSIP grant, in part, we believe, because of NSF's support of our laboratory program.*

- ($11,500 grant) *$50,000 challenge grant from private industry {was used} to improve lab facilities housing the instrumentation, plus $5,000 in {corporation} and NSF grants for undergraduate summer research.*

- ($15,000 grant) *Institution began {$24,000} development of unused space into labs and classroom. This development is not yet complete but is progressing and will result in 1 classroom, 1 animal housing room, 1 animal lab, 3 human research rooms, and 3 faculty offices.*

- ($7,100 grant) *Partly because of the CSIP grant, the geography/geology department is viewed by the university administration as a dynamic entity worthy of additional support. Therefore, they provided special funds {$3,100} for us to buy a personal computer, a 3-pen plotter, and a digitizer.*

- ($41,000 grant) *Just received a foundation grant of $50,000 (in addition to the first $50,000 from {corporation matching funds}) to add an additional lab (computer equipment, etc.).*

- ($10,300 grant) *This project allowed us to initiate our computer science lab. The lab has doubled in size last year {with $18,000 of additional equipment donations}. Many, many new projects have started. We also have a continuing lab budget.*

- ($23,000 grant) *{Corporation} funded a computer equipment grant partially because we already had a working microcomputer lab. We were given 8 more micro's, a mini and all the networking equipment, and 2 laser printers {worth $100,000}.*

- ($27,400 grant) *{We received} two state Tech/Engineering grants {which totaled} over $60,000, and a donated FT/NMR (worth over $80,000), largely as a result of the quality of our instrumentation and facilities begun with NSF grant.*

- ($20,000 grant) *After some smaller donations, $14,000 in upgrades, and deep discounts, {corporation} supported our project with a massive equipment donation {$250,000}, enabling us to finish the basic lab and expand to a second 'computing classroom.'*

These examples indicate that there were many situations where PIs gave CSIP credit for attracting significant additional resources beyond the initial grant. However, the data contain many other instances where it appeared the PI could have claimed even more in the way of CSIP-leveraged resources. Some examples of apparent under-counting follow.

- ($9,000 grant) *Our CSIP grant was evidence of program strength, and a contributor to space limitations involving laboratories. These factors were important in obtaining a $3.5 million grant from the {private} Foundation for a new physical science building.* (no additional resources were claimed)

- ($27,000 grant) *Definitely a contributing factor in our getting $494,000 ($200,000 in equipment) from a corporation for initiating a center for applied optics studies.* (only the $200,000 in equipment was claimed)

- ($24,000 grant) *Provided incentive to form a School of Science Biotechnology Facility (interdepartmental between Chemistry and Biology) and money to initiate equipment allocations.* (only $15,000 of initial allocations were claimed)

- ($35,000 grant) *We were able to raise funds to allow us to add chemical ionization mass spectroscopy and low temperature GC capability to our original package. We are now the lead institution in a project sponsored by the {private} Foundation to bring modern experiments to physical chemistry laboratories. We are also participants in a grant from the {second} Foundation to the college.* (no dollar amount was claimed for these additional resources)

- ($50,000 grant) *A {supplemental $83,000 corporation} grant was followed by additional requests resulting in $190,962 from the {same corporation} University Relations Board. Additionally, {a second} Foundation was convinced to contribute $500,000, with more than $250,000 being earmarked for electrical engineering labs.* (only $450,000 was claimed, $324,000 less than the sum of the amounts mentioned)

- ($20,200 grant) *The college received a grant from the {private} Charitable Trust of $994,000, and approximately $100,000 went to the Chemistry Department for equipment, and student and faculty research stipends.* (only the $100,000 was claimed, not the full $994,000)

- ($38,000 grant) *University has provided additional equipment to the cell biology program (centrifuges, analytical balance, etc.) which has greatly expanded the utilization of materials provided by the CSIP grant; university money also provided supplies and lab tech salaries through a research grant.* (only $10,000 in equipment was claimed; the grant was not)

- ($5,900 grant) *The college donated an additional 4 Macintosh plus computers and a printer, and upgraded 3 of our original Mac 512's to Macpluses. It also responded favorably to an internal funding request for 8 computers for upper level labs.* (the claimed amount for all of this, $6,000, seems too low)

- ($49,300 grant) *The presence of the equipment has facilitated several faculty research grants, and the college has purchased additional equipment to supplement what we bought on the grant: 2 centrifuges, HPLC, Elisa, spectrofluronieter.* ($65,000 in equipment was claimed, but the research grants were not)

- ($8,700 grant) *{We have received} a new science building addition (state funding) and $20,000 in equipment (we planned for a computer lab in our new facility in conjunction with our grant).* (only the $20,000 equipment was claimed, not the building add-on)

- ($28,800 grant) *The PI negotiated a long-term loan of an electron microprobe from {corporation} ($150,000). The Co-investigator received a separate NSF-ILI grant for purchase of a new SEM (dollar amount unknown).* (the microprobe was claimed, but not the SEM)

These and many other examples indicate that some CSIP grantees may have been too modest when assessing the effective use of their grants in attracting additional resources for their institutions. We can appreciate that a PI might think it immodest to claim that the recognition and credibility bestowed by a $9,000 CSIP grant was what made the difference in persuading a large foundation to fund a $3.5 million building at the college. But such an explanation is not implausible in the case of a small non-doctorate-granting institution that had not had a Federal grant of any kind for the 20 years preceeding the CSIP award.

The question of whether grantee questionnaires adequately account for leveraged resources beyond the initial grant is explored further in Chapter 3, which presents the results of site visits at selected institutions. At this point, however, suffice to say that the questionnaire-based estimate of $15.8 million in additional resources leveraged from CSIP projects appears too low.

Leveraging of Additional Space

In addition to further financial support, 200 grantees (one-quarter of the 1985-87 total) reported receiving additional space as a direct result of their CSIP project. About 130,000 total square feet was obtained, with an average of 640 square feet per affected project. It is difficult to place a dollar value on this space, and we have not attempted to do so, although it is apparent that lab space does have value and that CSIP-generated space is part of the return-on-investment for which NSF and its grantees deserve credit.

Curriculum Development

Another resource of substantial value leveraged by the CSIP program but not reported here in dollar amounts is the labor required integrate project equipment into the curriculum. Activities such as ordering, installing, and learning to use the equipment, developing new course materials, training staff, and integrating the equipment into the curriculum are essential to the curriculum improvements expected in the wake of CSIP grants. Principal investigators are estimated to have spent an average of 337 hours on project setup, none of which was paid for by CSIP grants. This subject is discussed in more detail in Chapter 6 of this report.

THE IMPACT OF CSIP PROJECTS ON STUDENTS, FACULTY, AND INSTITUTIONS

Highlights

This chapter focuses on the impacts operational CSIP projects have had on students, faculty, departments, and institutions. Because these impacts tend to be greater the longer projects have been in operation, most findings are broken out by CSIP program year. Data presented are from the grantee questionnaire and represent PI-provided judgments.

Especially strong positive student impacts were found in areas related to training of future scientists (including motivation and attitudes, career choices, and the presentation of papers), and these affected a broad range of the student population. Positive, energizing impacts on faculty were also found. However, only limited evidence was found of project impacts beyond the institutions, either through equipment sharing or dissemination of results. Additional encouragement of such activities would be a worthwhile future focus for the CSIP program.

Overall Project Success

According to PIs, most projects have accomplished what they set out to do in their proposals: when asked to give a success rating, almost all said their projects were either highly or moderately successful in this regard (Table 2-1). Only 2 percent indicated major problems, and about 3 percent (mostly 1987 grantees) indicated that it was "too soon to tell." The data suggest that success in achieving project objectives takes time: those that have been in operation longer are more likely to be rated as highly successful by PIs. More than three-quarters of 1985 grantees have projects they describe as highly successful, as do 69 percent of 1986 grantees, and 59 percent of 1987 grantees.

Table 2-1. Principal investigator's rating of the success of CSIP project by grant year: 1985-87

Rating	Grant year			
	Total	1985	1986	1987
Total	100.0%	100.0%	100.0%	100.0%
High success	67.5	77.3	69.2	59.3
Moderate success	27.6	20.3	27.5	33.0
Other	4.9	2.4	3.3	7.7

Source: Assessment of the 1985-87 College Science Instrumentation Program, Office of Studies and Program Assessment. NSF, 1990.

A related measure of the success of the CSIP program is whether the projects it has funded actively promote the objectives of the program. Respondents were presented with these CSIP objectives and asked to report which their projects exemplify:

- Introduction of modern instruments to improve the experiences of undergraduate students in science and engineering courses;
- Interfacing of computers with scientific instrumentation and other appropriate uses of current technology in science and engineering instruction;
- Development of new ways of using instrumentation to extend instructional capabilities; and
- Establishment of equipment sharing capability via consortia or centers.

Almost all projects report that they involve the *introduction of modern instruments*, the overarching objective of the program. Fewer, but still a majority, entail *interfacing computers with scientific instrumentation*, and *new ways of using equipment*. And, only about 6 percent of projects have established or intend to establish *equipment sharing consortia or centers* (Table 2-2).

Table 2-2. Principal investigator's report of the CSIP program objectives project exemplifies by grant year: 1985-87

Objective	Grant year 1985	1986	1987
Total	100 0%	100.0%	100.0%
Introduce modern instruments	96.6	98 9	91.3
Interface computers/instruments	55.8	60 4	57.6
New ways of using equipment	59 1	53.8	63.0
Share equipment/consortia	5.3	5.5	6.5

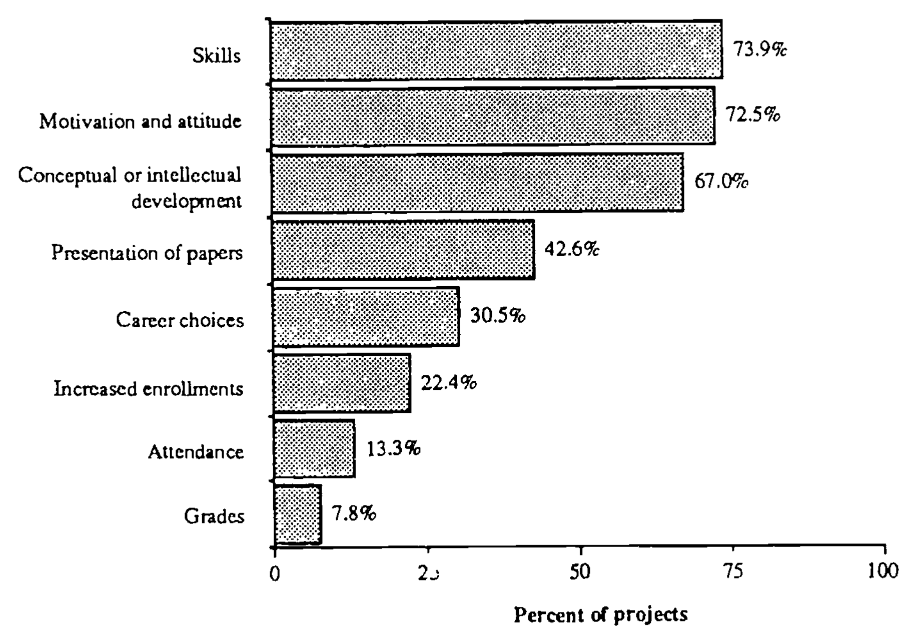
Note. Percents add to more than 100 because respondents could indicate more than one objective.

Source: Assessment of the 1985-87 College Science Instrumentation Program, Office of Studies and Program Assessment. NSF, 1990.

The figures for *interfacing computers with scientific instrumentation*, though respectable, are probably as low as they are because relatively few computer science or mathematics projects promote this goal. This activity is not often relevant to these fields, since it would mainly be used to gather data from experiments. The surprisingly high percent of projects that promote *new ways of using equipment* are projects that involve innovation, the development of new methods and techniques for instruction, which, it is hoped, will result in improvements beyond the isolated department.

Equipment sharing consortia or centers is the least often mentioned of the goals, and the lack of trend by year suggests that this goal is not one that is adopted late in the project. It seems that more could be done to encourage efforts toward this goal.

Figure 2-1: Percent of CSIP projects with positive impacts on students in various areas



Impacts on Students

Ultimately, of course, the success of projects, and of the CSIP program itself, should be measured by the impacts on students. CSIP projects deserve high praise here. As depicted in Figure 2-1, in several specific areas the PIs of operational projects reported substantial positive impacts on students (see also Table 2-3):

- A clear majority in each year reported improvements in skills, motivation and attitudes, and conceptual or intellectual development of students;
- Many 1986 and 1987 projects and 57 percent of 1985 projects reported improvement in presentation of papers;
- About a quarter of 1986 and 1987 projects and 42 percent of 1985 projects reported an increase in the choice of science careers; and
- About one in five projects reported an increase in science enrollments.

Table 2-3. Principal investigator's report of the positive impact of CSIP project on students by grant year: 1985-87

Area of impact on students	Grant year		
	1985	1986	1987
Total	100.0%	100.0%	100.0%
Skills	85.6	75.8	64.1
Conceptual or intellectual development	79.8	67.0	57.6
Motivation & attitudes	83.2	70.3	66.3
Grades	6.3	9.9	7.6
Attendance	8.2	14.3	16.3
Increased enrollments	23.6	22.0	21.7
Presentations of papers	56.7	40.7	33.7
Career choices	42.3	27.5	23.9

Note: Percents add to more than 100 because respondents could indicate more than one area of impact

Source: Assessment of the 1985-87 College Science Instrumentation Program, Office of Studies and Program Assessment, NSF, 1990

Impacts on these six areas are essential for improvement in scientific understanding and for the promotion of the professional development of fledgling scientists. It is encouraging for the future that in each of these areas the figures are higher for projects that have been in existence longer. The areas of grades and attendance, which are less crucial areas to impact, show the lowest figures.

Number of Student Equipment Users

The numbers of users and amount of use of CSIP equipment varies widely across projects. In the average project, 97 total students per year use the equipment, 68 in lab courses, 120 in lecture courses, 6 each for independent study and student research, and 39 for other purposes such as word processing (Table 2-4). The average student user employs the equipment for a total of 142 hours per year (or 4 hours per week during two 16-week academic semesters). Per user per year, student research averages 98 hours, independent study, 96 hours, and lab work, 68 hours.

Table 2-4. Principal investigator's description of CSIP project equipment users, reason for use, and amount of use: 1985-87

Purpose	Mean number of users	Mean hours used per year
Faculty users		
All	4.0	174.0
Instruction	3.5	109.4
Research	2.4	116.8
Student users		
All	97.0	141.8
Lab courses	67.8	68.0
Lecture courses	120.0	37.2
Independent study	6.5	95.8
Student research	6.0	97.6
Other purposes	38.8	123.2

Source: Assessment of the 1985-87 College Science Instrumentation Program, Office of Studies and Program Assessment, NSF, 1990.

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Profile of Students Impacted

A majority of the students impacted by CSIP projects were non-minority, non-handicapped, male, upper-division science majors. But, as shown in Table 2-5, CSIP projects did an impressive job at involving measurable numbers of other groups. For example:

- Of the students involved in the average project, 42 percent were female, compared to only 13 percent female in the science and engineering labor force[2];
- Thirteen percent of students involved were minority group members, compared to 10 percent minority in the science and engineering labor force;
- Just over 1 percent of students involved were handicapped; and
- Of all students involved in projects, 31 percent were freshmen and sophomores.

[2] National Science Board. *Science and Engineering Indicators-1989.* Washington, DC: U.S. Government Printing Office, 1989. (NSB 89-1). Appendix tables 3-2 and 3-4.

In addition, 6 percent were education majors, and 60 percent were science majors.

Some 40 percent of these students will go on to work at a related job after graduation, while just under 30 percent will attend graduate school, about 17 percent will attend medical school, and about 6 percent will work as teachers.

Projects in biology and psychology tended to involve a greater than average percentage of females; social science projects tended to involve a greater than average percentage of education majors; and mathematics and psychology projects involved a greater than average percentage of nonscience majors. Computer science and engineering projects were more likely than average to involve students who will work in a related job after graduation, and were less likely to involve students who will attend graduate or medical school, or teach after graduation.

Descriptions from Projects

PI descriptions of specific impacts of CSIP projects on students provide a more concrete view of the

Table 2-5. Principal investigator's report of profile of students impacted by CSIP project by field: 1985-87

Student type	Field										
	All	Biology	Chemistry	Computer Science	Engineering	Earth Science	Math	Interdisciplinary	Psychology	Physics/ Astronomy	Social Sciences
	(mean)										
In CSIP project											
Female	42.3%	56.2%	51.0%	32 7%	13.6%	34.1%	43.9%	45.3%	60.7%	21.9%	47 7%
Minority	12.8	12.7	14.9	15.5	13.3	3.4	11.2	7.1	7.7	15.3	19 7
Handicapped	1.3	1.0	.4	1.5	4.2	.2	.2	.9	1 4	1.0	4 0
Lower division	31 1	30.0	34.9	22 3	22.3	25.7	76.4	31.6	40.8	29.9	22 4
Education majors	5 5	4.9	4.5	5.1	7.6	9.1	10.6	5.5	2.2	4 1	13.0
Science majors	60.2	62.4	57.4	74.1	68.2	61.9	14.3	58.4	49.4	60.2	63 9
In department											
Attend graduate school	28.9	23.0	34.3	13.8	13.1	36 7	24.2	32.5	29 4	44.8	26.2
Attend medical school	16.6	29.2	25.4	1.7	3.0	1.9	12.1	16.4	8.4	6.9	8 4
Work in related job	40.2	24.0	32.9	85 4	74.3	47.9	40.5	36.8	30.0	35.7	47 7
Work as a teacher	6.4	10.0	4.7	2.4	2.1	7.0	15.3	7.3	8.4	6.5	8.0

Source: Assessment of the 1985-87 College Science Instrumentation Program. Office of Studies and Program Assessment, NSF, 1990.

kinds of student impacts represented in these abstract statistics. These range from improvements in skills and motivation to enhanced preparation for graduate school and jobs in related industries.

- *Computer-driven simulations and demonstrations have really made the course material come alive for the students. In addition, we can cover more material in a semester because phenomena that might take several minutes for me to describe in lecture can be easily demonstrated (and experienced) in seconds.*

- *{Student} skills have improved with better tools. The opportunities afforded by the new equipment automatically enhance the opportunities for intellectual development . . . Motivation and attendance are both up. We are over-enrolled with a waiting list. Several using the advanced equipment have produced very good papers, and we have a stronger flow of majors.*

- *The greater sophistication of the experiments that students are involved in has led to both a greater skill level and a higher level of intellectual development. There is a spill-over effect. The rapidity with which the GC/MS provides useful information allows students to do more. This in turn leads to further development of skills other than in the use of the GC/MS and the increased richness of the program leads to greater intellectual development. The acquisition of the GC/MS was part of a plan for improving the program here which has raised student morale and motivation to the highest level that we have known. The number of chemistry majors has increased by about 50 percent, and the number going to graduate school has approximately doubled. This is clear evidence of an effect on career choices. Student productivity has increased and this has resulted in an increase in the number of student co-authored papers. Student presentations have increased in number and in sophistication.*

- *Since the level of the equipment used in training requires greater conceptual ability of the students, they are motivated to study and work harder, which in turn increases their skills, intellectual development and attendance. Student grades are climbing a bit more since their motivation and attitude toward the work load has improved. Previously only two papers were sent by students to Engineering competition (both winning papers)--this year we expect to have to screen papers to get to maximum allowed entries. General audience presentations have shown a marked improvement. We have noted a small slide-over of students to our program from the conventional Engineering program.*

- *Students tell us the course has been very valuable in helping them find good positions upon graduation. One student was hired primarily because she was the only candidate for a laboratory position who had the computer interfacing experience.*

- *Two of our students have gone on to pursue graduate work in areas that they first explored here with the new equipment. Almost all of our students are asking for opportunities to do undergraduate research.*

- *{Students have} increased computer/instrument skills: several students have presented results of t' research (using the new instrument) at American Chemical Society local section symposia.*

- *Following the completion of this project faculty have observed a general increase in the quality of work completed by students, level of difficulty of projects students engage in, and have received positive reports on recent graduates from employers.*

- *{Project} has had an even greater effect than anticipated . . . for at least four reasons. It has: (1) greatly reduced the apprehension with which students with little practical experience with apparatus approach GC/MS and helped them to develop confidence; (2) allowed greater sophistication in choice of synthesis projects for first semester; (3) allowed students to make much greater progress in projects; (4) allowed true 'hands-on' use by students as they see need. In sum students are able to do more interesting experiments and to carry them further. It has had equal impact on student research. Since acquisition of the computerized GC/MS the level of student accomplishment in research has risen sharply. While the GC/MS is not essential to all projects, the majority of students use it. They provide a critical mass and their accomplishments set a standard which other students feel the need to meet, and so we now have a higher level of expectation and accomplishment in undergraduate research.*

Impacts on Faculty

The importance of faculty impacts should not be underestimated, since the morale and motivation of the teachers of undergraduate science will have a direct bearing on the quality of teaching. The impact on faculty members in institutions with CSIP projects is clear and positive. Among PIs, 80 percent indicated that the CSIP program had benefitted their faculty, ranging from 92 percent for 1985 grants to 73 percent for 1987 grants (Table 2-6).

Table 2-6. Principal investigator's report of the impact of CSIP project on selected areas by grant year: 1985-87

Area	Grant year			
	Total	1985	1986	1987
Total	100.0%	100.0%	100.0%	100 0%
Improved curriculum	86.0	96.6	87.9	77.2
Benefitted faculty	80.0	91.8	78 0	72.8
Produced transferrable products	26.7	30.3	28.6	22.8
Found other equipment uses	69.4	62.7	77.5	69 4

Note. Percents add to more than 100 because respondents could indicate more than one impact.

Source. Assessment of the 1985-87 College Science Instrumentation Program. Office of Studies and Program Assessment, NSF, 1990

Amount of Faculty Equipment Use

An average of four faculty members used equipment associated with a CSIP project, for an average of 174 hours each per year (or 5 hours per week for two 16-week academic semesters; Table 2-4). Faculty members used the equipment for both instruction and for research. Their instructional use averaged 109 hours per year (or 3 hours per week for two 16-week academic semesters), while research use averaged 117 hours per year (or 4 hours per week for two 16-week academic semesters).

Descriptions from Projects

There is clear evidence from narrative statements that CSIP grants had strong energizing, revitalizing effects on many faculty members of recipient departments:

- *By removing one significant inhibition the computerized GC/MS has allowed faculty to engage in more ambitious and more interesting research projects. There is also an important contribution to morale.*

- *Benefits to faculty include: lab prep (set-up time) and maintenance less time consuming, availability of instrument for research (as benefitted three faculty), the success of the proposal and project was ~~very~~ beneficial to PI (a first-year assistant professor in tenure track position at time of grant).*

- *Two faculty members benefitted most by learning to use all of the different items of equipment. Our enthusiasm about the project proposal, getting the award, and putting the project in place has not diminished. We wish we had more time to develop additional experiments which involve the project equipment.*

- *The CSIP money drew the attention of our administration to the importance of Molecular Biology/Biotechnology. They have contributed heretofore unheard of resources to the program (a total of about $250,000). The equipment has driven a remarkable improvement in the performance of the four faculty using it. I hate to imagine what we would be doing now in the absence of the CSIP funds.*

- *As other faculty have observed our integration of microcomputers into the classroom, they have become excited about possibilities for their courses. Two of our faculty have received and completed grants to prepare software for biological exercises. Some of this software is in use at other institutions.*

- *We have progressed a great deal in using computers both in the lab and in our courses. They have given us a great amount of work and satisfaction. We have learned a lot; from assembly language to learning how to interface an A/O converter.*

- *Faculty skills have been improved through actual instrument use and {through} special courses, including the American Chemical Society short course on Environmental Analytical Chemistry.*

Impacts on Departments, Institutions, and Beyond

There is evidence that many CSIP projects have had substantial and widespread impacts, especially within the institution itself. Most PIs said their projects had improved the overall curriculum, and more than a quarter said they had produced instructional products that are transferrable for use in other institutions (Table 2-6). Almost 70 percent of PIs reported they have found uses for their equipment in addition to CSIP project activities.

Dissemination Efforts

Formal dissemination efforts that would spread curricular improvements beyond the host institution are not extensive, although two-thirds of the PIs reported that their projects have elements worth disseminating. Dissemination activities that have occurred so far include the almost 40 percent of PIs who have given presentations on their projects, the quarter who have shared course materials, and the 20 percent who have published papers.

Table 2-7. Principal investigator's report of dissemination efforts related to CSIP project: 1985-87

Dissemination effort	Projects
Total	100.0%
Elements worth disseminating	68.1
Received outside inquiries	54.2
Received information from other projects	27.0
Held collegial discussions on project	57.0
Responded to inquiries on project	44.9
Did presentations on project	39.0
Shared project course materials	25.3
Published project findings	20.2
Shared equipment with other institutions	11.2

Note: Percents add to more than 100 because respondents could indicate more than one dissemination effort.

Source: Assessment of the 1985-87 College Science Instrumentation Program, Office of Studies and Program Assessment, NSF, 1990.

Informal dissemination efforts are more common. More than half of PIs have held collegial discussions on their projects, and about 45 percent have responded to inquiries (often about their successful proposals; Table 2-7). Small numbers have also shared software, given tours, given high school workshops, written newsletters, shared with other departments, taken field trips, and presented faculty minicourses.

Descriptions from Projects

Elaborations by PIs on the kinds of improvements attributable to their projects and the dissemination efforts they have undertaken provide further evidence of the impact of the CSIP program.

- *Our astronomy lab program has become excellent! We are doing things that amaze other institutions' faculty. We've given two papers, one at an international astronomical union symposium on the teaching of astronomy, and one at a regular meeting of the American Astronomical Society. We have established contacts and developed materials for many who are interested in replicating our lab program.*

- *The GC/MS is now used in organic lab, spectroscopy, instrumental analysis, and undergraduate research. A continuing education course on GC/MS was taught to staff at the Illinois Environmental Protection Agency. We have developed a lab on the analysis of benzodiozedine tranquilizers that is being prepared for publication. Preliminary results were reported at the New Orleans American Chemical Society meeting.*

- *We were able to advance the curriculum by offering a networking lab class, which increases the student's learning experience by giving hands-on opportunities. We've had indirect impact on the rest of our facilities in that the equipment purchased for the project showed its capabilities and provided the model for the upgrade of the rest of our labs.*

- *{Products include} an experiment involving quantitative analysis by GC/MS {which} has been published as a result of this grant in the* Journal of Chemical Education. *This represents the first instructional procedure of its kind in print.*

- *Because I wanted a forum to share my thoughts on this course, problems encountered and solved, I organized a state-wide symposium on biotechnology, which attracted faculty from most of the {state} system (both biology and chemistry departments represented). This has now evolved into a superb state-wide organization dealing with biotechnology.*

- *The curricula developed have been shared by presentation of papers at the American Chemical Society Meeting in 1986, ASBC meeting in 1988, publication of a paper in* The Journal of Chemical Education, *and {through} response to numerous inquiries from individual faculty from Delhi, India to Czechoslovakia!*

- *We have given seven different presentations on our work at local meetings (the state Association of Physics Teachers), and one at the national meeting at Cornell (summer 88), on software and hardware developed, and on experiments developed.*

- *A presentation was made at the 1987 New Orleans meeting of the American Chemical Society. Equipment use and project discussions with five local companies and two nearby colleges have taken place. Three of the companies now have purchased equipment identical to ours.*

- *We believe that this instrumental support makes the idea of an integrated laboratory more viable. This should interest other institutions as should some of our specific materials. We have had several inquiries from other institutions about the project and several requests for copies of the proposal. We have presented material at an American Chemical Society meeting and will present more. There are as yet no publications, but we anticipate several. We are willing to share use of the equipment with local institutions, but have no formal arrangements to do so.*

CSIP IMPACTS REVISITED: SITE VISIT FINDINGS

Highlights

Post-survey site visits were made to a stratified probability sample of 49 CSIP projects by teams consisting of a contractor representative and a peer reviewer -- an academic scientist/engineer who was familiar with the CSIP program and knowledgeable in the field of the project being visited. The visits generated several kinds of information:

- Vignettes written by the independent peer reviewers who participated in the site visits provide concrete illustrations of the many different ways that CSIP projects have achieved educational impacts far in excess of what might have been expected from the modest financial investments represented by the initial CSIP grants. Some instances were found of projects that had not worked out as well as had been hoped, but the site visits produced many more success stories than stories of promise unfulfilled.

- Site visit assessments of the accuracy/validity of grantee-provided questionnaire data indicate that while most questionnaire data were accurate, grantees tended to err in the direction of understating project impacts.

- An important indicator of the extent to which the CSIP program was responding to needs that otherwise would not be addressed is the assessment that 85 percent of the 1985-87 CSIP projects would not have been implemented or would have been significantly scaled back in scope and impact had the grant not been received.

- Sixty-nine percent of CSIP projects were judged to be highly successful in achieving their original goals; nearly all of the rest were judged moderately successful in this respect.

- Most CSIP projects were judged to have had positive educational impacts on areas such as:

  - Students' understanding of the subjects being taught with the project (90%);

  - The quality of teaching in the affected courses (88%); and

  - The quality of students' preparation (82%).

- Areas where significant problems were found were in *ordering, installing, and learning to use the equipment* (42%), and in *operating and/or maintaining the equipment* (38%).

- For 84 percent of the projects, the PI's initiative, effort, and time on task were judged to have been highly positive factors contributing to the project's success in achieving its objectives. There were other contributing factors as well for many projects, but none as important as the PI.

Qualitative Findings

The site visit teams were extremely impressed by some of the projects visited. Some examples from the peer reviewers' summary assessments follow.

- *This project is doing extremely well. Apart from its direct impact on several courses and student research participation it has had a catalyst effect on several other activities in the department. Three additional CSIP proposals were generated (two thus far funded) and other sources of support for biology programs located. Together with industry donations of equipment and some additional funding from the college, biology has created an impressive teaching/research environment for its majors. There is a definite upbeat feeling among the faculty, despite heavy teaching loads created in part by the success of their program. They are also generating an extraordinary number of students who continue on to some graduate work in the field (20-25 per year) for a college with a total enrollment of 1,000.*

- *This is a terrific project! They have leveraged NSF's 15.7 K into a beautifully equipped lab on which they have spent almost 80K (over a 4-1 match). The department head says that "we have never had a grant on this campus with this much impact." They have upgraded the curriculum, are using the instruments in biology and anthropology as well as chemistry, are preparing to offer pre-med and pre-dent, now offer a concentration in chemistry under the physical science degree, and all attribute the upsurge to a snowball effect created by the CSIP grant. This project is exactly what CSIP wanted to accomplish; NSF should go see this one and take the congressional committee members with them.*

- *{The institution} now has a state-of-the-art instrument room, which Perkin-Elmer helped them design. The CSIP equipment is complete, in place, and in use in instruction. A permanent chemistry position has been added as a result of the CSIP instrumentation, and two new courses have been added. The state Science and Math High School is now at {the institution} (some feel as a result on CSIP), a subsequent state grant has been received and the college is now helping the chemistry department to find additional funding sources. This CSIP activity at {the institution} is a textbook example of what CSIP was designed to accomplish.*

- *Project is doing very well. PI is older and has been at the institution for over 30 years, he says if he had been denied CSIP funding he probably would have retired. As it is, he gave his nights/weekends/summers to setting up the project--which has since become the centerpiece of a newly dynamic department. Students benefit from the equipment and PI is doing research and publishing again. PI's efforts have been exceptional.*

- *{The PI} decided to split the system (both hardware and software) into two independent systems, one for analysis and one for graphics, and bought different hardware (Zenith) and software (MAP and MYSTAT) for these purposes. The result is a stunning package with unbeatable graphics and virtually unlimited analytical capability. The chemistry department is copying his system, and he has helped the biology department write a CSIP grant. This is a genuine model. NSF should visit {this school} and disseminate this one.*

- *This project is in place, on track, and very well received. The only variation from the proposal is a Varian AA instead of Perkin-Elmer (PE did not bid under the state requirements). This was the first chem grant, and started the "ball rolling" (two more since then). Both the PI and the department head say CSIP was directly responsible for acquisition of a Mass Spec (58k). The CSIP instruments and the MS are used in recruiting, and they anticipate 3-4 graduating majors per year (compared with past average of two per year). Still small numbers, but now they have a means of recruitment. The PI feels that CSIP has a role in her tenure and promotion. This project is seen by all as very successful for itself and very influential in stimulating a climate for change on the campus.*

- *The support of the administration, from chair through dean through higher administrators has been substantial. There has been some release granted to the PI (2 teaching hours out of 12), although this was not recognized in his report. A substantial overmatch of $35,000 was originally generated. Subsequent to that an additional $30,000 was also provided. Since the report, an additional major piece of equipment was also provided. Space in the school is always at a premium, and they have used this grant to leverage a future lab (by 1992) with over $100,000 in renovation. The PI received a $2,500 Meritorious Performance and Professional Promise Award for getting this proposal. It is clear that the proposal was initiated by the PI, and that the chair and dean then took a major role in leveraging the money to maximum advantage.*

- *It would be difficult to imagine a project more successful than this one: The availability of one-time state appropriations allowed 3 to 1 matching. All equipment is up and running without glitches. All courses in program were reviewed and revised; new equipment has been introduced in general courses to sophomores(!), and then used in 10 other courses in department as well as senior seminar and master's projects. Formerly they showed slides and used data from books; now they use labs and field work. The system is fully computerized-even lab reports are written with the word processor and spreadsheet programs. The program, according to dean, is now a "flagship" of the School of Health Sciences; the department has been given a new tenure stream faculty position, which all interviews indicated as unusual and the clearest sign of institutional support. The grant was the first such on campus. The dean cited the program as an important factor in a recent $100,000 state grant to interest inner city youth in science. Their master's program has grown dramatically. They boast "100 percent placement" of Environmental Health program graduates; every E.H. internship leads to an offer, and more students onto graduate school. The E.H. laboratory is now on all campus tours to recruit students. Program has gained prestige on campus and with industry; "doors that used to be closed are now open"(PI). In all cases, the PI, the department chair, and the dean said it was the one CSIP grant that made all of this possible. The* *university would not have even supported the program to such an extent by itself.*

Of course, not all CSIP projects were as spectacularly successful as those noted above. For one reason or another, a few of the projects visited clearly had not been as successful as the PI (and NSF) had hoped.[3]

- *One project suffered from a severe fiscal crisis at its host institution, a small private college that has been experiencing declining enrollments, faculty cutbacks and growing financial difficulties in recent years. The school was unable to provide even the minimal matching funds until fully 3 years after the CSIP award (apparently, an honest misunderstanding about the amount of time allowable under the program). Consequently, the project has been very slow to develop. The equipment has now been assembled, but problems of inadequate space, increasingly limited PI time, and acute declines in department enrollments have conspired to limit its impact.*

- *Another project at a small private college involved a single large instrument and was aimed at upper division students. Since the original proposal, the number of upper-division students in the department has declined to a level of only one or two graduates per year. In any case, the distributor from whom the instrument was purchased went out of business shortly thereafter, and the PI has had great difficulty keeping the instrument in working order. At the time of the site visit, it was down again, and it had been continually out of service for the past 6 months.*

- *The PI at this mid-sized public institution was an untenured recent PhD in a department whose senior members were not equipment oriented. Since the award, two other young faculty members who had planned to participate in this CSIP project had been denied tenure and had left the institution. Without their support, the installation and integration of the project equipment has taken more time than the PI had anticipated and has limited his ability to participate in other tenure-enhancing activities. If he, too, is denied tenure, he fears the project equipment will fall into disuse.*

- *At another mid-sized public institution, the co-PI who was the principal initiator and author of the CSIP proposal has since taken on administrative and other responsibilities at his institution and has turned the project over to the other co-PI, whose interests in the equipment are very narrow. The equipment is being used, but less extensively and with considerably less student impact than NSF had anticipated.*

In a large program such as CSIP, it seems inevitable that there will be a few problem projects such as these. However, such projects were very much the exception, not the rule. Most commonly encountered were solid, well-implemented projects that are accomplishing their goals, and maybe a little more. Additional examples from the peer reviewer summaries follow.

- *This is a project that will produce a modest impact each year for a long time, perhaps more than 30 years. The cumulative result should be substantial. The instrument, a high quality gravity meter, has a very long useful life. It will produce meaningful geological information for several decades. Already two student projects have been completed. The availability of the instrument has made it possible to prepare a proposal to obtain funds for more student project work. Student laboratory exercises are currently being prepared through cooperation between geology and physics faculty members. The availability of this gravity meter opens ongoing opportunities for student projects, and the PI is actively pursuing these opportunities. The gravity meter definitely enhances the quality of undergraduate education at {this institution}.*

- *This project is doing well. This is one of the finest examples of what the CSIP program is about that I've seen. It is the core for a totally integrated modern lab program for the entire department. Staff are enthusiastic. They also have been remarkably successful in using CSIP/NSF funds as stepping stones to other funding.*

- *This is a model program. The funds have provided equipment that allow students to acquire data and analyze data in state of the art fashion. The PI and collaborating faculty have done an outstanding job of incorporating this equipment into their program. Some of the software and hardware could be useful to other schools if some*

[3] The examples include excerpts from presurvey site visits as well as from postsurvey visits.

method of distribution could be found. Carefully conceived, well executed, well documented.

- *The project is doing extremely well. All of the project goals have been attained. The physics department staff have given time and careful attention to this project. The equipment directly impacts approximately 10 students (majors) per year. However, indirectly it is impacting the laboratory structure of all of the physics classes. Lab procedures and experiments are being changed even in the Introductory Lab to better prepare the students to deal with computer/experiment interfaces and computer/data acquisition techniques.*

- *This project is quite successful. The PI and his colleagues have fully implemented the proposed modifications to existing course and curricula. They are now using the equipment to move beyond the initial applications. There has been widespread departmental involvement in computerization of laboratory activities and considerable positive spin-off in undergraduate and graduate student research.*

- *The PI and his colleagues used this proposal to leverage more funding from the institution and, hence, have carried this program farther than originally planned.*

- *This project, as well as this entire institution, is growing and developing at an incredible rate. The ICP is being used as planned by the PI in his classes. In addition, much student undergraduate research is being conducted, as evidenced by a number of publications. Instructors in other departments have found valuable uses and their involvement is leading to more interdisciplinary activities. As this institution has, as of now, no graduate program in the field, their students must go to other institutions for such work; but in a number of instances involving several different institutions this instrument is not available, and they return to this institution for their research. The PI has been put on their committees to expedite the process.*

- *This grant has had a major positive impact on the biology program. Prior to the grant, the major emphasis was on systematic biology, ecology, natural resources, etc. The addition of the biotechnology has resulted in a new minor in cellular and molecular biology despite the fact that no new courses were introduced. This came about because of the upgrading of courses in genetics, immunology, cellular molecular biology, etc. Because of this grant, they anticipate a new option in biotechnology. The departmental chair indicated that these changes resulted in increased medical school admissions.*

- *This is clearly an example of a successful operation of the NSF program to enhance undergraduate education in the sciences. The requested High Pressure Liquid Chromatograph (HPLC) was purchased, installed and used in the intended course on schedule and without mishap. It has had a positive impact in the intended course which is offered at a level affording a good undergraduate preparation in analytical chemistry. Such a preparation is very important for the typical career goals of the student population in this department. Since this instrument is only used for a part of the Instrumental Analysis course, it could not have revolutionized things; but a positive impact was evident. The instrument is furthermore being used in undergraduate student research and figures slightly into a new course on microprocessor controlled instrumentation. It may also figure into a new biochemistry lab course under development. Two faculty use the instrument in their direction of student research.*

- *{The PI} has developed an outstanding program in experimental psychology. The program allows students to experiment on an individual basis by using computers. {The PI} first initiative was the upgrading of his statistics course. This resulted in the development of an entire laboratory manual for the Mac Plus and Mac II. This has not been published, but it is a perfect example of what needs to be shared and made "public" by CSIP investigators. Once again, the weakest part of the CSIP program shows itself here-failure to provide for dissemination of information. {The PI} is now working on the psychology manual. This, too, should be disseminated.*

- *This project is very successful. It has brought an expensive, sophisticated, and essential instrument to the chemistry department. Without this funding, they would probably not have this capability. The instrument is being used by several groups within chemistry (organic, physical, and analytical) for undergraduate research. Access to this instrument has generated much pride and enthusiasm within* *the department as well as providing a state-of-the-art instrument for training undergraduates.*

- *The {project} is a model that has made a positive impact at all levels of the college. The curriculum interfaces with related disciplines and it has received full institutional support. The course is a product of innovative change within the department. The laboratory provides a hands-on experience in molecular biology that has resulted in improved skills, increased numbers of independent study projects, enrollment in related courses, and student presentations at national and regional meetings. The course is well designed and successfully team-taught. {The project} has achieved the original goals and beyond the expectations of the dean.*

- *Impact on students appears substantial-excited, enthusiastic to work with research-level equipment, rather than just being told such equipment exists. Anecdotal evidence suggests students now working in industry found experience on equipment helpful (especially to get job in first place).*

- *This project is doing exactly what the PI proposed. It is providing a close to the state-of-the-art Digital Signal Processing facility to a well defined clientele, the students in the DSP class. It is also addressing needs generated by their research and allowing analysis of data. They have been able to build on the original equipment granted and create an excellent facility.*

- *The impact of this instrument on upper-level students is very high, as the instrument sees extensive use in three courses: molecular spectroscopy (required for the major), inorganic chemistry (required) and methods of measurement (optional). Each student uses the instrument for one to two afternoons per semester; the rotating schedule of labs indicates that the instrument is used extensively nearly every week of the semester. The use of this instrument in the introductory organic course has not yet been developed. This instrument is also heavily used by students involved in independent research. The response of students has been uniformly positive and enthusiastic.*

- *This instrument was useful for catalyzing the conversion of a stockroom into an instrument room housing not only the FTIR, but also four other instruments. The instrument is maintained by faculty, in conjunction with the electronic shop staff. Such a task, like the task of writing the research grants for shared instrumentation, is viewed by the department chairman as a standard part of the job of faculty. The Dean of Faculty, however, commented that equipment maintenance is "a real problem" and suggested that it is a poor use of faculty resources which may now not be appropriate.*

Validation Findings

After inspecting the project equipment, curricula, publications, and other materials, and interviewing the PI, the department head, the dean, and others, the post-survey site visit team members jointly assessed whether the PI's questionnaire understated, overstated, or accurately communicated the project's actual status with respect to several dimensions. The findings, weighted to represent all 1985-87 CSIP grantees, are summarized in Table 3-1.

Table 3-1. Site visit assessment of the accuracy of CSIP grantee questionnaire data: 1985-87

Dimension	Assessment of questionnaire information			
	Total	Understates	Overstates	Accurate
Extent of progress in implementing project.	100.0%	16.9%	12.2%	70.9%
Extent of change from planned equipment.....	100 0	10.9	0.0	89.1
Extent of change from planned objectives......	100.0	6.0	0.0	94.0
Extent of resource leveraging. Total	100.0	24.6	7.5	67.9
Projects reporting $5.000+	100.0	45 7	8.7	45.6
Projects reporting <$5,000	100.0	18.5	7.1	74.4
Extent of other project impacts............	100.0	35.8	0.0	64.2
Type and extent of dissemination....	100.0	5.7	0.0	94.3

Source: Assessment of the 1985-87 College Science Instrumentation Program, Office of Studies and Program Assessment, NSF, 1990.

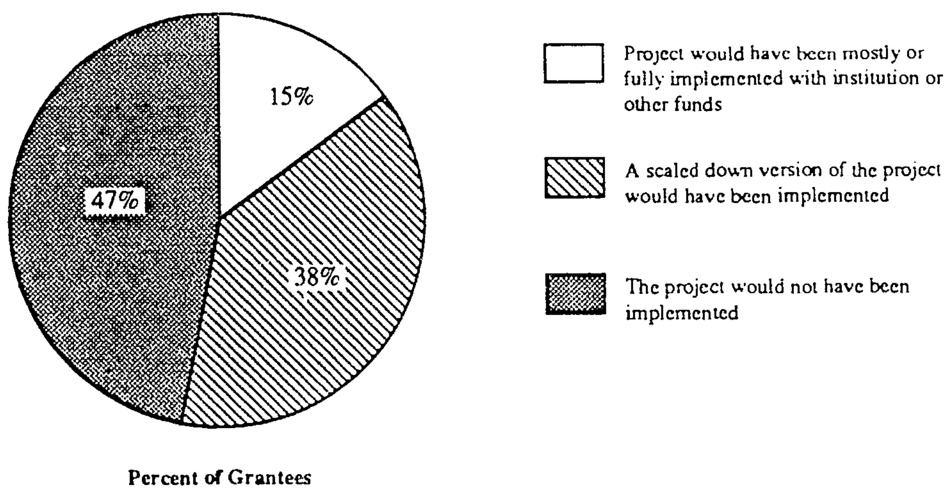
Generally, the site visitors found the questionnaire data to be quite accurate. The only clear pattern that emerged was a strong tendency of PIs to understate positive project impacts when reporting on their questionnaires, a finding that ran counter to expectations. For instance, 36 percent of PIs were judged to have understated the educational impacts of their projects, and 46 percent of the PIs who reported $5,000 or more in equipment or resources over the required match were found to have significantly underreported these dollar amounts. Exaggeration of outcomes was almost never a problem. This is an important finding, which suggests greater effort will be needed in future evaluations to obtain a full and complete accounting of project impacts, both financial and educational.

Other Site Visit Findings

Would Projects Have Occurred Without CSIP?

Given that all of the supported projects were judged by CSIP proposal reviewers to be highly meritorious, the possibility arises that many might have come to fruition even if the CSIP program had not existed. In some cases, for example, it is possible that PIs may have had explicit commitments for full project support from other sources in the event that the CSIP award was not received. The hypothetical question of what would have happened to the project if CSIP funding had been denied was explored in the site visit interviews with PIs and department heads. The results are summarized in Figure 3-1.

Figure 3-1: Site visit assessment of whether projects would have occurred without CSIP



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Based on the assessments of the site visit teams, only 15 percent of CSIP projects would have been mostly or fully implemented with funding from institution or other sources if the CSIP grant had not been received. For the overwhelming majority of projects (85%), the CSIP grant was of critical importance to the development of the project; without it, projects would either have been significantly scaled back (38%) or not implemented at all (47%). Perhaps more than any other single finding from this evaluation, this assessment underlines the extent to which the CSIP program is addressing real needs that would not otherwise be met. Without CSIP, many of the proposals to obtain modern instrumentation for use in undergraduate science/engineering education, even those most needed and most meritorious, would find it difficult or impossible to obtain the necessary financing.

Degrees and Areas of Project Success

The site visit teams made summary assessments of the extent to which individual projects have been successful thus far in various respects (Table 3-2). Most projects (69%) were judged to have been highly successful in achieving the goals set forth in their proposals, and most of the rest (29% of the total) were judged moderately successful in this respect. In terms of the four CSIP program goals that respondents were asked to consider, upwards of 80 percent of the projects that sought to achieve a particular goal were judged to have been at least moderately successful to date. An exception is the CSIP goal of establishing equipment sharing consortia, where the assessment data are somewhat muddy: many projects were rated as having had no success in this area, but most had not had this as a goal.[4]

[4]As noted in Chapter 2, only 6 percent of CSIP grantees' proposals addressed this goal.

Table 3-2. Site visit assessment of CSIP project success: 1985-87

Dimension	Project success				
	Total	High	Moderate	None	Not ascertained/ Not applicable*
Achieving its original goals	100.0%	69.4%	29.2%	1.4%	(0.0%)
Introducing modern instruments to improve the experiences of undergraduate students in laboratories and field work	100.0	72.6	20 2	7 1	(4.2)
Interfacing computers with scientific instrumentation for instruction purposes	100.0	51.0	32 4	16.7	(30.2)
Developing new ways of using instrumentation to extend instructional capabilities	100 0	38.0	51.0	10.9	(17.4)
Establishing equipment sharing capability via consortia or centers	100.0	5.4	7.9	86 6	(37.4)
Leveraging additional funds (beyond the required match)	100.0	27.0	40.2	32.8	(0.0)

*Projects for which assessments were not ascertained or not applicable were excluded when computing other percentages

Source: Assessment of the 1985-87 College Science Instrumentation Program, Office of Studies and Program Assessment, NSF, 1990

Another goal that was seldom listed as such in CSIP proposals was that of obtaining additional funds to expand beyond the scope of the initially proposed project. As shown in Table 3-2, over two-thirds of all CSIP projects had achieved some expansion beyond what was originally proposed, and over one-fourth (27%) were judged to have been highly successful in this respect.

Types of Project Impacts and Problems

The site visit teams assessed whether projects had as yet had positive (or perhaps negative) impacts (Table 3-3). As hoped, the highest levels of consistently positive impacts were found for students and for curriculum and instruction (e.g., in the area of curriculum, 88% of projects were judged to have had positive impacts on the quality of teaching in the affected courses). Negative impacts were found in only two areas:

- On the PI, whose workload often increased materially (44%) and whose ability to take on other professional obligations was sometimes diminished (21%); and

- On short-term funding, either because of difficulties in obtaining the required matching funds (10%), or because once special efforts had been made to provide the matching funds, the PI or department moved to the end of the line in laying claim to any additional funds that might become available (7-10% of the time).

In both of these areas, however, positive impacts were also seen. Obtaining CSIP grants was thought to have had positive impacts on future funding prospects for the PI or department far more often than negative impacts (62-65% vs. 7-10%), and CSIP-related PI workload increases were sometimes accompanied by salary increases (29%) or improved chances of obtaining tenure (45% of PIs who had not been tenured at the time of the award were viewed by site visitors as strong candidates for tenure after the award).

Table 3-3. Site visit assessment of CSIP project impacts 1985-87

Type of impact	Nature of impact			
	Total	Positive impact	No impact	Negative impact
Curriculum and instruction				
New/modified courses	100.0%	73 0%	27.0%	0.0%
New/upgraded topics	100.0	87.8	12.2	0 0
Teaching of subject....	100 0	87.6	12.4	0.0
Department faculty				
Morale........	100 0	71.3	27.2	1.5
Interest in upgrading . .	100.0	74 7	23.8	1 4
Recruitment....	100 0	48.8	51.2	0 0
Principal Investigator				
Possibility for tenure.....	100.0	45.0	55.0	0 0
Salary............	100.0	29 4	70.6	0.0
Work load....	100.0	11.0	44.9	44.1
Other professional obligations............. .	100.0	29.8	49 4	20 7
Students				
Level of interest......	100.0	76.2	23.8	0.0
Understanding of subject.................	100 0	90.5	9.5	0 0
Preparation	100.0	82 1	17.9	0.0
Science instruction				
Usefulness as model . .	100 0	57 6	40.9	1 5
Funding				
Acquiring matching funds	100 0	83 2	6 8	10.0
Leveraging additional money	100.0	64 8	28 4	6 8
Department				
Prestige	100.0	87.6	11.5	1.5
Funding level	100 0	61.6	28.2	10.2
Space	100.0	38.5	59.6	1.8
Student enrollment.. ...	100 0	34.2	65.8	0 0
Student recruitment....	100.0	44.8	55.2	0 0
Faculty recruitment......	100.0	41.1	58 9	0 0
Instructional program .	100 0	90 8	9.2	0.0
Institution				
Grant administration process..	100 0	40.2	58 3	1 5
Institutional support.....	100 0	68.5	30 1	1 4
Prestige	100.0	58.8	41.2	0.0
Student recruitment......	100.0	41.7	58.3	0.0

Source: Assessment of the 1985-87 College Science Instrumentation Program, Office of Studies and Program Assessment, NSF, 1990.

The site visit teams also explored the extent to which projects had been held up or PIs had to expen more effort than anticipated because of certain problems (Table 3-4). Significant delays in acquiring the matching funds were a major problem for an estimated 12 percent of the projects, but 71 percent of the grantees had no problems in this area. A significant proportion of the grantees (42%) experienced significant delays or problems in ordering, installing, or learning to use their CSIP equipment, and 25 percent had major delays or problems. Even so, 58 percent of the grantees reported no problems in this area. Problems operating or maintaining the equipment were seldom major (8%), but neither were they uncommon: 38 percent of the projects had at least minor problems in this area.

Factors Contributing to Project Success

Many factors contributed to the success of individual CSIP projects. Other faculty, department and institution administrators, and even student assistants often played significant roles (Table 3-5). By far the most important factor, however, was the initiative, effort, and time on the task of the grant PI, who was the major contributor to the overall success of the project over 80 percent of the time.

Table 3-4. Site visit assessment of problems contributing to CSIP project delays or requiring the PI to expend more effort than anticipated to stay on schedule 1985-87

Problem area	Extent of problem			
	Total	Major	Minor	None
Acquiring funds..	100 0%	11.8%	17.0%	71 1%
Ordering, installing, and learning to use equipment	100 0	25 4	16 3	58 2
Operating and/or maintaining equipment	100 0	8.5	29.9	61.6

Source Assessment of the 1985-87 College Science Instrumentation Program, Office of Studies and Program Assessment, NSF, 1990

Table 3-5. Site visit assessment of the contributors to the success of the CSIP project: 1985-87

Contributor to project success	Assessed contribution					
	Total	Major	Modest	Slight	None	Negative
PI's initiative, effort, time on task	100.0%	83.7%	5.9%	7.0%	0.0%	3.5%
Other faculty	100.0	24.0	20 1	27.7	28.2	0 0
Department administrators	100 0	30.1	9.1	30.3	25 0	5 4
Institution administrators	100.0	19.2	24.2	23.2	24.1	9.3
Student assistants	100 0	.4	20.2	18.5	59.1	1.8
Others	100.0	28.1	16.8	0 0	55.1	0 0

Source: Assessment of the 1985-87 College Science Instrumentation Program, Office of Studies and Program Assessment, NSF, 1990

A more detailed assessment of the institution's role in the development and implementation of CSIP projects is presented in Table 3-6. As shown, while institutions were often supportive in encouraging PIs to submit CSIP proposals and later in providing needed supplies and help with equipment maintenance and repair, institutions seldom were actively involved in the preparation of proposals (19%), and only infrequently gave PIs release time to work on the implementation of their projects once the CSIP grant was received (13%).

These findings reinforce the questionnaire data in suggesting that, while CSIP grants are made to departments and institutions, it is the individual PI who is the principal and most important contributor to outcomes at each step, from the initiation and development of the proposal to the eventual installation and actualization of the project itself.

Table 3-6. Site visit assessment of the institution's role in CSIP project development and implementation: 1985-87

Areas of institution support	Level of support			
	Total	Some support given	No support given	Problem area
At the proposal stage				
Initiation of proposal	100 0%	42 7%	57.3%	0 0%
Encouragement of submission	100.0	85.6	14.4	0.0
Preparation of proposal	100.0	18.9	81.1	0.0
At the implementation stage				
Release time	100 0	12 6	80.8	6.5
Additional space	100 0	40.9	54.9	4.2
Supplies	100.0	76.5	22.1	1 4
Technical support.. ..	100 0	48.5	42.5	9.0
Provisions for maintenance and repair	100 0	71.9	8.5	19.6

Source. Assessment of the 1985-87 College Science Instrumentation Program. Office of Studies and Program Assessment. NSF. 1990

OUTCOMES FOR UNSUCCESSFUL CSIP APPLICANTS

Highlights

Almost 70 percent of the proposed PIs were denied funding for their CSIP projects from 1985 to 1987. These unsuccessful CSIP applicants report mixed effects of the proposal writing experience. On the one hand, the planning process was often viewed as a valuable opportunity to evaluate current curricula and facilities and to establish goals. These plans, once set in motion, often came to fruition with further effort. On the other hand, more than 35 percent of these unsuccessful applicants have not acquired any of the proposed instruments, often to the detriment of undergraduate science education at their institutions.

Outcomes

In stimulating PIs to conceptualize, plan, and budget projects to benefit undergraduate instruction at their institutions, and then to convince their departments, institutions, or others to commit matching funds in the event a grant is made, the CSIP program may create a momentum that will continue even if the grant is not awarded.

Information relevant to this speculation is presented in Table 4-1. As shown, a majority of the unsuccessful CSIP applicants did continue their efforts to obtain project funding support (61%), and of these, 76 percent have been able to obtain at least some such support. Of the 1,681 unsuccessful CSIP applicants, 64 percent have been able to obtain at least some of the equipment they requested for their proposed CSIP project. The mean is 53 percent of the original project budget.

If we assume the average budget for both unsuccessful and successful CSIP applicants was about the same (i.e., about $47,000), this 53 percent of the budgets of 64 percent of the unsuccessful applicants amounts to about $27 million of additional instructional equipment indirectly generated by CSIP. If this is included in calculating the return on NSF's financial investment, the return increases from 450 percent in direct return (from Chapter 1) to about 600 percent return altogether.

Table 4-1 Proposed principal investigator's report of the consequence of unsuccessful application for CSIP funding for the implementation of the proposed project: 1985-87

Index	Percent
Effort made to obtain alternate funding	
All nonfunded projects	61
Alternate funding obtained	
All nonfunded projects	47
Those who made effort	76
Proposed instruments obtained	
Those who made effort	64
Portion of original CSIP budget request obtained instruments represent	
Those who made effort	53
Alternate funding sources	
Department	46
College/university	60
Federal government	17
Business/industry	16
Other	22
Further funding efforts anticipated	
All nonfunded projects	44

Source Assessment of the 1985-87 College Science Instrumentation Program, Office of Studies and Program Assessment, NSF, 1990.

In their questionnaire, unsuccessful applicants were also asked to describe in their own words the positive or negative effects of their participation in the CSIP program. Half reported positive effects of one kind or another, including grant writing practice, use of the same proposal to submit elsewhere, forced examination of the curriculum or department, and attention brought to the department. Some excerpts from their statements follow.

- *Kept me alert to new developments and made us evaluate the people who are now in the field.*
- *I was able to use basically the same proposal to apply to other sources!*
- *After preparation of the first CSIP proposal, others were easier.*
- *Plans were crystallized, goals set.*

- *Clarified our needs.*

- *Communicated effectively to local administration need for instrumentation in the chemistry curriculum. Focused dialog in the department on improving instruction by changing methodology.*

- *The door was opened to seek alternative means of establishing our goals.*

- *I learned how to prepare an NSF type grant.*

- *It helped me review our program and see where it could be improved.*

- *Yes, the attitude of faculty and students improved for having been involved or aware of the pending proposal.*

- *Provided me with the experience for proposal writing.*

- *We were able to revise the proposal and obtain enough of the equipment to serve the original purpose.*

- *Part of the narrative was used to solicit funds from sources on this campus.*

- *The proposal served as a catalyst for curricular review within the biology department. Extensive changes in the core courses and several upper-division courses have occurred over the past 2 years.*

- *The proposal helped initiate evaluating our laboratory equipment needs. We have continued to pursue and refine the stated equipment needs in later years.*

- *Administration recognized at a new level the need for faculty support in this area.*

- *Cooperative effort between my animal science department and biology department.*

Some examples of negative impacts include students' loss of experience with equipment, a perceived diminishing of the prestige of the PI or the department, and disappointment or discouragement on the part of PI or department. Their statements include the following observations:

- *Mild depression on the part of the author. Many hours of work produced not even any real evidence that the project was seriously considered.*

- *It did delay our 'hands-on' introduction of NMR spectroscopy to our students.*

- *Possibly lowered morale after two consecutive failures.*

- *We had to wait 4 or 5 years before we could get any decent equipment.*

- *It has inhibited expansion of our teaching activities in this area.*

- *Caused diversion of funds from one project to another and delayed the implementation of other projects that must now gather dust on the shelves, that are equally meritorious. The people of this area will lag behind the population centers in their knowledge of science, etc.*

- *Frustration--it seems those who really are in dire need of external support are not funded whereas those with existing facilities always get more.*

- *It discouraged future proposals--since in this proposal the reviews were not negative and there was no indication of what could be done to improve chances next time.*

- *Delayed by 3 years the establishment of the computer teaching laboratory.*

- *Since I could not obtain adequate funding to have the equipment necessary to teach experimental physics at a level necessary to allow students to survive after obtaining a BS, I became disillusioned, quit teaching, and went into industry.*

- *Lack of funding resulted, indirectly, in the program being dropped. A number of conservative individuals resent this type of innovative program. Had it been funded we could have overridden their votes and influence. The students of course are the big loser as the program is no longer available to them. Some of the younger faculty also miss the advantage of this type program.*

- *Of course our students do not have the benefit and training on up-to-date equipment.*

- *It was a significant factor in my decision to leave {school}. Several faculty and students who realized physiological psychology had been long neglected at {school} were disappointed. The college experienced some interruption in the transition from myself to my replacement.*

- *Was denied promotion and tenure at application institution.*

- *It does make it harder to interest and maintain faculty when equipment begins to age and support is not forthcoming.*

- *Sure discouraged us as a small college.*

- *I could have made teaching more exciting!*

- *This school does not have a good academic reputation. Your denial of the request just simply confirms it.*

It seems that failure to receive funding can have very different impacts. As shown above, specific outcomes for individuals and departments are often dependent on circumstances unique to the submitting institution and individual.

PART 2

PROGRAM CHARACTERISTICS

CSIP PROGRAM REACH

Highlights

This chapter provides a broad description of CSIP program participation during its first 3 years of operation.

Both the number of CSIP awards and the success rate of proposals increased between grant years 1985 and 1987 as increased funding became available. During this period, CSIP grants were distributed across fields in proportion to the number of proposals received. PIs' academic credentials and department characteristics generally did not appear to affect likelihood of award, and grantees' proposals were no different from unsuccessful applicants' proposals in their initiation or authorship. However, the following factors were associated with likelihood of success in winning CSIP awards:

- The extent to which the proposal addressed the stated CSIP program goals, and especially the extent to which it proposed innovative uses of instrumentation for undergraduate instruction;
- The persistence of individual PIs in submitting revised proposals if not successful initially;
- (In certain fields) the total number of undergraduates being served by the department; and
- At the school level, the total number of CSIP proposals submitted over the 3 year period, especially whether the number was one or more than one.

Numbers of Proposals and Principal Investigators

According to NSF program records, 3,226 CSIP proposals were submitted during the 3 years of the program, and 780 grants were awarded (Table 5-1). Following an initial surge of 1,335 proposals in 1985, the number of proposals levelled off to 922 in 1986 and 969 in 1987. The trend in grants awarded, however, went in the opposite direction: as greater CSIP funding became available, the number of grants increased from just over 200 in 1985 and 1986 to over 300 in 1987. Consequently, the program award rate grew from only 18 percent in 1985 to 35 percent in 1987.

Table 5-1. CSIP proposals, awards and applicants by grant year, 1985-87

Number of proposals and PIs	Grant year			
	Total	1985	1986	1987
Proposals				
Proposals received .	3,226	1,335	922	969
Grants awarded . ..	780	234	?11	335
Award rate.	24 %	18 %	23 %	35 %
PIs (unduplicated)				
Total........	2,449	1,196	529	724
Grantees.......	768	234	210	324
Unsuccessful applicants....... .	1,681	962	319	400

Source. Assessment of the 1985-87 College Science Instrumentation Program. Office of Studies and Program Assessment. NSF. 1990

Some PIs submitted multiple CSIP proposals during 1985-87 (though never more than one per year). As shown in Table 5-1, the 3,226 proposals received in 1985-87 were submitted by a total of only 2,449 different PIs; this means that participating PIs submitted an average (mean) of 1.3 proposals each during this period.[6] This duplication is eliminated in the lower section of Table 5-1 and in all subsequent tables in this report, where individual PIs are assigned to a single status category based on their earliest winning proposal. Thus, a PI who submitted an unsuccessful proposal in 1985 and a successful one in 1986 is classified as a 1986 grantee; a PI who submitted unsuccessful proposals in both 1985 and 1986 is classified as a 1985 unsuccessful applicant. PIs who submitted at least one unsuccessful CSIP proposal in 1985-87 and had no winning proposals during that period will be classified as unsuccessful applicants in this report.

[6] This probably understates the real rate of resubmission, since it is based on computer matching of PI names. Situations where a proposal was resubmitted under a different name are not included.

Fields, Levels, and Objectives of Proposed Projects

As shown in Table 5-2, chemistry (27%) and biology (21%) received the largest numbers of CSIP grants in 1985-87, followed by engineering (12%) and physics/astronomy (12%). The distribution across fields was very similar for grantees and unsuccessful applicants, indicating that CSIP grants in a given field were made in close proportion to the number of proposals received in the field.

Grantee proposals were about evenly divided between those that would affect upper-division students only (45%) and those that would affect both upper- and lower-division students (50%). Few successful proposals were addressed only to lower-division students (5%). Level information was not available for unsuccessful applicants from the 1985 CSIP, but for the 1986 and 1987 unsuccessful applicants, proposals had approximately the same distribution by level as found for the grantees.

Grantees and unsuccessful applicants were not so similar when asked which of the four CSIP program goals their proposed projects addressed (Figure 5-1). While over 90 percent of both groups said their projects would promote the first goal, *introduction of modern instruments to improve the experiences of undergraduate students*, substantially more grantees

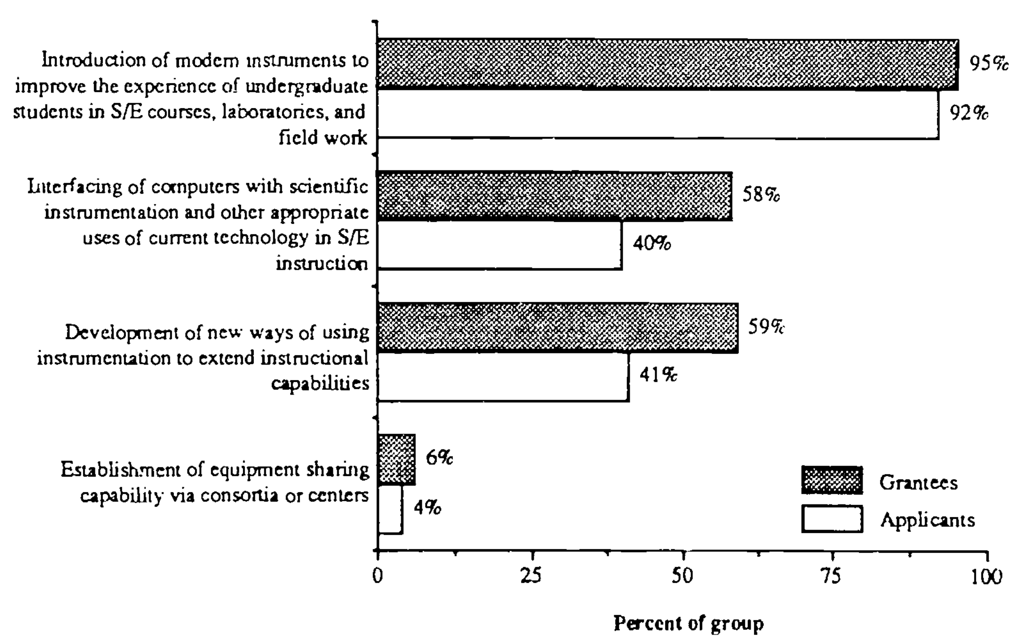
Table 5-2. Field and level of proposed CSIP projects by award status, 1985-87

Field and level	Grantee		Unsuccessful applicant	
	Number	Percent	Number	Percent
Field				
Total	752	100.0	1,681	100.0
Biology	158	20.7	341	20.3
Chemistry	204	26.8	404	24.0
Computer science	32	4.2	117	7.0
Engineering	95	12.5	218	13.0
Earth science	37	4.9	78	4.6
Interdisciplinary	65	8.5	152	9.0
Mathematics	11	1.4	33	2.0
Psychology	46	6.0	88	5.2
Physics/astronomy	89	11.7	213	12.7
Social sciences	24	3.1	38	2.3
Level				
Upper division only	343	45.1	282	39.2
Both divisions	377	49.6	365	50.8
Lower division only	40	5.3	72	10.0
Unspecified	2	n.a. *	962	n.a. *

*Row was not included in calculation of percents

Source: Assessment of the 1985-87 College Science Instrumentation Program, Office of Studies and Program Assessment, NSF, 1990.

Figure 5-1: CSIP program goals addressed by grantee and applicant proposals: 1985-87



than unsuccessful applicants claimed that their projects would also involve *interfacing of computers with scientific instrumentation and other appropriate uses of current technology in science and engineering instruction* (58% vs. 40%), or *development of new ways of using instrumentation to extend instructional capabilities* (59% vs. 41%). It appears that CSIP proposal raters looked for projects that involved more than just making additional equipment available to undergraduates; projects that also involved creative ways of using equipment to enhance curricula appear to have been more likely than others to receive funding.

We might also speculate that successful CSIP proposers had a better understanding than unsuccessful applicants of the importance of addressing NSF's specific objectives for the CSIP program, as stated in the guidelines for proposals. Proposals that overlooked these program objectives apparently had lower chances of success in obtaining funding.

Characteristics of Grantees and Unsuccessful Applicants

Most CSIP grantees (93%) hold doctorate degrees (Table 5-3). About three-fifths were tenured and were associate or full professors when the proposal was written, and about three-quarters of them are now -- 2 to 4 years later. At the time of the survey, grantees had been at their current institutions for an average (mean) of 12 years and had held their highest degree for an average of 15 years. The mean teaching load among grantees was 12 hours per week, both when the proposal was written and currently.

Unsuccessful applicants as a group have a very similar demographic profile; if anything, they as a group were slightly older and slightly more senior academically than the grantees. This pronounced similarity between the two groups, both before and after the CSIP proposal/award process, suggests that the PI's academic credentials were not a major factor affecting CSIP awards. These data do not allow a clear conclusion with regard to the effects of award receipt or nonreceipt on the PIs' subsequent career development, at least not in terms of such elements as tenure, title, and teaching load. Even so, qualitative data from site visits presented in Chapter 3 suggest there may be some positive effects for awarded PIs.

Table 5-3. Academic characteristics of CSIP proposed principal investigators by award status: 1985-87

PI characteristic	Grantee		Unsuccessful applicant	
	At time of proposal	Currently	At time of proposal	Currently
Total	100.0%	100.0%	100.0%	100.0%
Highest degree				
Doctorate	n.a *	93.2	n.a	90 1
Master's	n.a	6.0	n.a	8.7
Bachelor's	n a	.8	n.a	1.2
Tenure status				
Tenured	58.4	74.2	62.9	74.8
Untenured	38.5	22.6	33.0	20.2
Not tenure track	3.1	3.2	4.0	5.0
Academic title				
Full professor	37.0	43.7	41 6	47.5
Associate professor	26.3	30.8	22.0	27.7
Assistant professor	33 8	20.8	25.3	11.6
Department chair	.8	3.0	4.1	3 4
Other	2.1	1.7	7.0	9.8
Teaching load				
Mean hours per week	12.0	12.0	12.8	12 6
Years since highest degree				
Mean	n.a.	15.2	n.a.	17.9
Years on current faculty				
Mean	n.a.	12.4	n.a.	13.9

*Information was not obtained

Source: Assessment of the 1985-87 College Science Instrumentation Program. Office of Studies and Program Assessment, NSF, 1990.

Development of the Proposal

Funded CSIP proposals seldom originated as a result of initiative from the college administration or from the department head (Table 5-4). Most grantees' proposals were initiated by the PI (78%), and most also were written by the PI (83%). It would have been interesting if unsuccessful applicants had evidenced a different pattern, but they did not: most nonfunded proposals were also initiated and written by the proposed PI.

Table 5-4. Factors in the development of CSIP proposals by award status: 1985-87

Proposal factor	Grantee	Unsuccessful applicant
Proposal initiator		
PI	78 4%	79.6%
College administration	13.0	8 9
Department head	2.6	6.7
Other	6.0	4.8
Proposal author		
PI	83 4	85.6
Department committee	12.2	11.7
Other	4 4	2 7
Previously applied for funds for this or similar project		
Total (1985-87)	34.5	14.4
1985	14.9	10.7
1986	44.0	24.0
1987	42 4	15.7
Previously received other grant funding		
Federal and/or other	71.5	65 6
Federal	48.9	39 8
Other	53.6	47.2

Source Assessment of the 1985-87 College Science Instrumentation Program, Office of Studies and Program Assessment, NSF, 1990.

One factor that did differentiate grantees from unsuccessful applicants was whether or not the PI had previously applied for funds for a project that was the same as or closely related to the current CSIP proposal. Grantees more often reported such previous experience, especially in 1986 and 1987 when more than 40 percent of grantees reported previous applications, primarily unsuccessful CSIP applications. In contrast, only 16 to 24 percent of the unsuccessful applicants applied previously. This suggests that, after the first year of the program, many of the successful CSIP proposals were submitted by PIs who had been turned down on their first try and successfully addressed the reviewers' concerns in their resubmittals.

Another indication of the beneficial effects of practice and experience in writing proposals is that, in addition to previous applications for their CSIP projects, grantees were more likely than unsuccessful applicants to report previous experience in obtaining grant support for other projects (72% vs. 66%), from both Federal and non-Federal sources.

Characteristics of PIs' Departments

In terms of mean number of faculty, percent of faculty holding Ph.D. degrees, or mean number of graduating undergraduate majors, grantees' and unsuccessful applicants' departments were quite similar (Table 5-5).

Table 5-5. Characteristics of departments submitting CSIP applications by award status: 1985-87

Department characteristic	Grantee	Unsuccessful applicant
Faculty		
Mean number	10.3	11.2
Percent with Ph.D.	77.5	73.7
Graduating majors		
Mean number per year	24 5	23 1
Undergraduate fall enrollees		
Mean number, all S/E fields	512	360
Biology	454	228
Chemistry	473	281
Computer science	651	841
Engineering	266	287
Earth sciences	202	203
Interdisciplinary	461	204
Mathematics	1,140	711
Psychology	1,221	881
Physics & astronomy	342	270
Social sciences	1,557	859

Source: Assessment of the 1985-87 College Science Instrumentation Program, Office of Studies and Program Assessment, NSF, 1990

However, in terms of total departmental undergraduate opening fall enrollment in 1987, the mean for grantees was substantially higher than that for unsuccessful applicants (512 vs. 360). This difference was seen in all fields except computer science, engineering, and earth science, and was very pronounced in mathematics, psychology, and the social sciences, where grantees' departments served averages of 1,140 to 1,557 undergraduates versus averages of 711 to 881 for unsuccessful applicants' departments. These fields all serve relatively large numbers of lower-division students, and one might speculate that CSIP projects that incorporate modern instrumentation into the curricula of lower division students would be more likely to receive funding if the number of students to be affected is relatively large.

Institution Success in Obtaining CSIP Awards

The institutions eligible to participate in CSIP during the 1985-87 period were the country's 2,706 4-year, non-doctorate-granting schools. A total of 811 schools, 30 percent of those eligible, sent one or more CSIP proposals to NSF at some time during those 3 years (Table 5-6). This total is not the sum of applicant schools for the three individual years, but rather reflects a large degree of overlap in schools applying from year to year. This overlap is illustrated by noting that the 670 schools applying in 1985 constituted 83 percent of all the schools that ever applied in 1985-87, the 508 in 1986 were 63 percent of all applying, and the 494 in 1987 were 61 percent of that same group. Of all eligible schools, 70 percent made no CSIP applications in any of the three years covered in this evaluation.

Of the 811 schools that did apply, 410 (51%) received funding for one or more proposals at some time in the 1985-87 period. Within the period, school-level success rates increased gradually, from 28 percent in 1985 to 47 percent in 1987. This year-to-year trend was also seen in the data for individual PIs and (again) reflects the increased CSIP funding that became available in 1987.

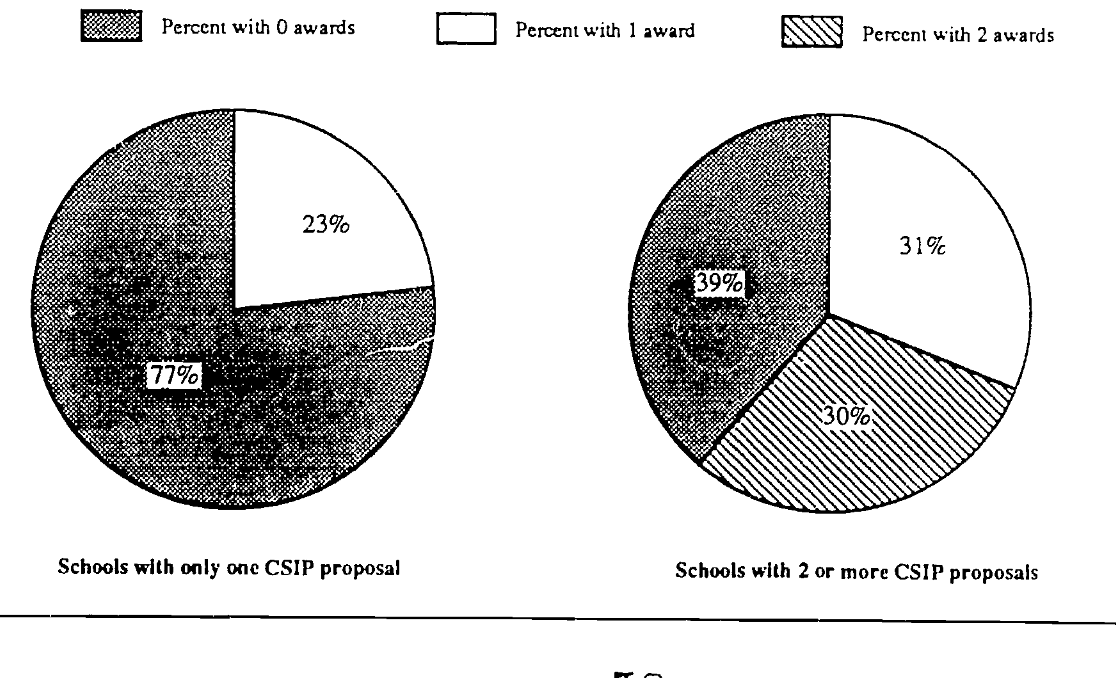
Table 5-6. Rates of CSIP participation and success for eligible institutions, 1985-87

Index	Grant year			
	Total	1985	1986	1987
Percent of the 2,706 eligible schools that submitted any CSIP proposals	30.0	24 8	18.8	18.3
Of schools that submitted proposals, percent with one or more funded............	50.6	28.4	34 8	47.4

Source Assessment of the 1985-87 College Science Instrumentation Program, Office of Studies and Program Assessment, NSF, 1990

It was noted earlier that individual PIs who persisted by submitting a revised proposal if their first effort failed often achieved success on the second try. The benefits of persistence in program participation were also evident at the institution level, where success levels were much lower for institutions that submitted only one CSIP proposal in 1985-87 (23%) than for institutions submitting more than one proposal (Figure 5-2). The latter group had a 61 percent chance of receiving at least one award, and had a 30 percent chance of receiving two or more awards.

Figure 5-2: Institutions' success in winning CSIP grants in 1985-87 as a function of number of proposals submitted



CSIP PROJECT DEVELOPMENT AND IMPLEMENTATION

Highlights

After a brief overview of the current status of 1985-87 projects at the time of the survey, this chapter describes the process of CSIP project development from notification of funding to full implementation.

CSIP projects generally were implemented as proposed and in less time than the 30 months allowed by the program, reflecting well on the quality of the planning process at the proposal stage. Most 1985 through 1987 grant-year projects were close to full implementation at the time the questionnaires were completed, and the majority of project changes noted in the questionnaires appear to be expansions or other improvements. The few PIs who decided on alternate equipment did so generally to better fulfill their curriculum development plans.

The tasks involved in basic project setup were numerous and time consuming, requiring many hours of work by the PI and others, often including other faculty and students. Where the PI and other faculty dedicated themselves to the project, and the cooperation of the administration was obtained, implementation went most smoothly.

Project Progress and Adherence to Schedule

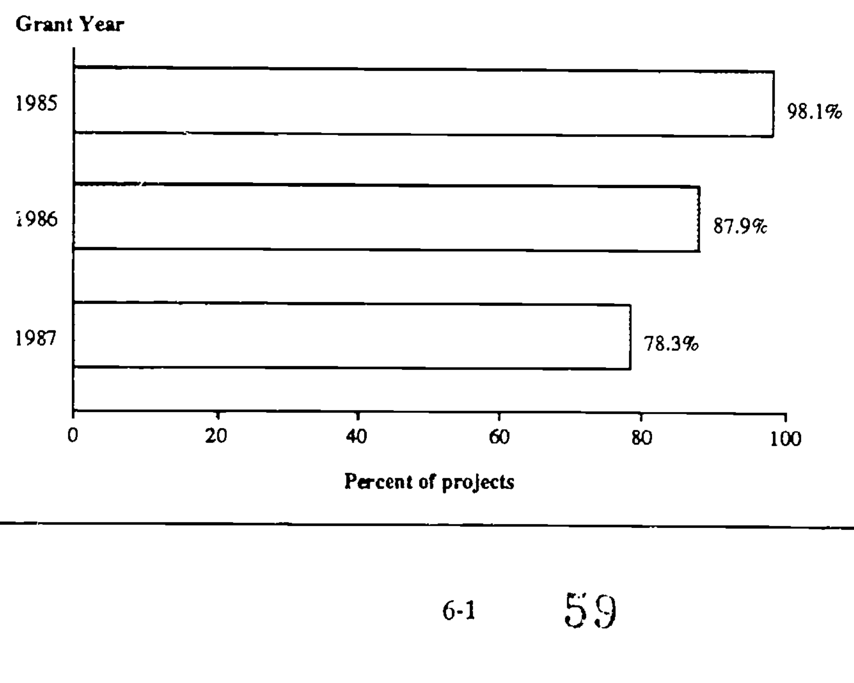
Most CSIP projects are close to full implementation. The majority of projects in each of the grant years surveyed are mostly or fully operational, meaning that most equipment has been purchased and installed, and most course materials have been developed and tested with students (Table 6-1; Figure 6-1). Considering that 1987 projects were only a year and a half into their two-year (30 month) grants at the time of the mail survey, this is quite remarkable. In addition, only a handful of projects have made little or no progress. Underscoring the importance of planning for CSIP projects is a tendency for PIs who previously applied to fund the same project to be further along than those who were first-time applicants when funded.

Table 6-1. Principal investigator's report of the progress of CSIP project by grant year: 1985-87

Progress	Grant year 1985	1986	1987
Total	100.0%	100.0%	100.0%
Fully operational	88.0	75.8	37.0
Mostly operational	10.1	12.1	41.3
Partly operational	1.9	11.0	13.0
Not yet operational	0.0	1.1	8.7

Source: Assessment of the 1985-87 College Science Instrumentation Program, Office of Studies and Program Assessment, NSF, 1990.

Figure 6-1:-- Percent of CSIP projects that are fully or mostly operational: 1985-87



CSIP projects also closely follow the time schedules set out in proposals. Most PIs report that their projects are on or ahead of schedule, and few report that their projects are behind schedule. In general, as projects have more time to progress they are more likely to be on or ahead of schedule: close to 85 percent of 1985 and 1986 grantees report their projects are on or ahead of schedule, versus 74 percent of 1987 grantees (Table 6-2). Also, grantees who previously applied for CSIP funding for their projects are more likely to be on or ahead of schedule than those receiving grants on first application (85 percent versus 79%). This may be a function of the additional development time related to the preparation of two proposals.

The PI's institutional experience is also a factor in the timeliness of project implementation. If the PI has been a faculty member at the institution for only 1 to 6 years, the project is more likely to be behind schedule (28%) than if the PI has been a faculty member for 7 to 15 years (15%) or 16 years or more (16%). On the other hand, replacement of the PI seems to slow projects down: when the original PI is still overseeing the project, 82 percent are ahead of schedule or on schedule in contrast to 72 percent of projects where the original PI has been replaced.

Departure from Original Proposal

Equipment Changes

Most projects closely follow the equipment plans proposed: there were virtually no significant changes reported between the equipment proposed for the project and that actually purchased. As seen in Table 6-3, two-thirds purchased the exact equipment proposed, and another 32 percent purchased equipment that was functionally equivalent to that in their proposal. Less than 2 percent of projects underwent any substantial equipment substitution.

Table 6-3. Principal investigator's report of equipment changes to CSIP project from original proposal by grant year: 1985-87

Equipment purchased	Grant year			
	Total	1985	1986	1987
Total	100.0%	100.0%	100.0%	100.0%
Same as proposed	66.6	70 7	72.5	59.8
Same function	31 6	26.0	26.4	39.1
Equipment same/different purpose	4	1.4	0.0	0.0
Different equipment and purpose	1.3	1.9	1.1	1.1

Source: Assessment of the 1985-87 College Science Instrumentation Program. Office of Studies and Program Assessment. NSF. 1990.

The reasons for changes in the equipment purchased generally fell into four categories. One reason was to take advantage of an opportunity to buy more advanced or newer models of the proposed equipment. Some examples in the grantees' own words:

- *Instrument purchased had superior spec's (optical performance, etc.) to originally proposed equipment, & manufacturer's discount made it affordable.*

Table 6-2. Principal investigator's report of the status of CSIP project by selected characteristics: 1985-87

Project status	Total	Grant year			Previous applicant status		PI status		Years on faculty		
		1985	1986	1987	Yes	No	New	Original	1-6	7-16	16 or more
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Ahead of schedule	6.0	8.7	5.5	4.3	8.3	5.2	7.9	5.8	3.9	7.9	6.0
On schedule	74.8	78.3	79.1	69.6	76.9	74 1	64.6	75.7	68.5	76.8	78.3
Behind schedule	19.2	13.0	15.4	26.1	14.8	20.7	27 4	18.5	27.6	15.4	15.7

Source: Assessment of the 1985-87 College Science Instrumentation Program, Office of Studies and Program Assessment, NSF, 1990.

- *Newer technology made more sophisticated equipment available within our cost range.*

- *{Vendor} was willing to 'deal' for the IR & HPLC systems as a package so, coupled with a larger overmatch from the college, we were able to purchase gradient HPLC systems with an integrated rather the simple isomatic unit proposed. In addition, the ratio-recording model IR was supplied.*

- *I purchased a computerized physiobiological recording and biofeedback system instead of the conventional system which I had planned to buy at the time my proposal was submitted. The computerized system employs more advanced technology, is more versatile, and is easier to operate.*

- *Altered equipment specifications in order to: 1) save money, 2) achieve same original project objectives, 3) used savings to extend scope of project by purchase of additional equipment.*

- *Between the time we submitted and were consequently awarded the CSIP funding, DEC came out with the Microvax II To replace the Microvax I. The latter was in our original proposal, but we ended up purchasing the newer (and better) Microvax II.*

A second reason was the location of a more economical source for the proposed equipment, resulting in the ability to purchase a more advanced instrument or additional components:

- *Was able to get a large enough discount for a more expensive instrument.*

- *Different vendor had better equipment--improved design.*

- *Different equipment due to state's low bid procedure.*

- *Lower prices allowed us to outfit two computers instead of one.*

- *Cost bidding for equipment allowed us to purchase additional instrumentation.*

- *A change in vendor allowed us to purchase 12 phase contrast microscopes at a lower cost--allowing the purchase of a refrigerated table-top centrifuge. We substituted a deionizing system instead of requested on the advice of the manufacturer.*

A third reason was that, as some projects were implemented, the PIs learned more about the equipment and found that modifications or expansions made the project more workable or would allow more students to participate:

- *We changed the type and number of computers purchased, so that each lab group can have a computer. This makes a system that is much better than what was proposed.*

- *We had a compatibility problem between the Tektronix terminals and the proposed monitors for the classroom. We substituted an overhead projection system which cost about $10,000 more than proposed.*

- *The scanning electron microscope required some unanticipated modifications to facilitate use of the EDS system.*

- *Because the project included about 100 separate components, it required extensive discussion and testing to put together the best set of components. Some changes were required.*

- *The equipment proposed initially proved to be cumbersome in column changing and better suited to functioning as a dedicated process instrument. We are very happy with the alternate instruments we chose.*

- *By ordering a more economical printer/plotter, we were able to purchase a demo auxiliary computer system thus enabling two students to use the system at the same time--one to acquire IR spectra while another is using the auxiliary computer for data interpretation.*

And, in some cases, equipment changes were necessitated by circumstances beyond the control of the PI:

- *Some equipment that we hoped to purchase became unavailable. We used the money to purchase (better) components and we are having one recently hired machinist assemble/build these devices.*

- *The proposed equipment (some of it) is no longer manufactured. The replacements were more expensive, requiring some changes in the plan.*

- *Change in faculty caused consequent alteration in focus of advanced labs and student research.*

- *Failure of my university to provide adequate lab space (as promised) has necessitated not purchasing one piece of equipment.*

Other Project Changes

Other changes between the proposed and implemented projects were also minimal (Table 6-4). Only about 18 percent of projects made changes to their originally proposed curriculum development plans, and 20 percent made changes to their originally proposed course content. About 1 in 10 projects made changes to their original plans in the areas of format, audience, and course level. The proportions making plan changes tends to be slightly lower for more recent years, perhaps indicating that changes evolve over time, as the PI has more experience running the project or the implementation becomes more complete.

Table 6-4. Principal investigator's report of other changes to CSIP project from original proposal by grant year: 1985-87

Changes	Grant year			
	Total	1985	1986	1987
Total	100 0%	100.0%	100.0%	100.0%
Curriculum	18.1	25.5	14.3	15.2
Format	11.2	15.4	12.1	7.6
Content	20 1	23.6	25.3	14.1
Audience	10 0	12.5	11.0	7.6
Course level	9.0	10.6	7.7	8 7

Note: Percents may not add to 100 because not all PI's reported changes

Source Assessment of the 1985-87 College Science Instrumentation Program. Office of Studies and Program Assessment. NSF, 1990.

Generally, respondent explanations of the changes made in their CSIP project plans fell into three categories. The most frequently mentioned had to do with expansion of the project in terms of content or the number or level of students reached:

- *What we could do with the equipment became more clear as we actually used it. The lab exercises, in format and content (and, thus the lab curriculum), evolved with the project.*

- *Instruments purchased with these funds are being used in more courses than originally proposed. They have had a greater impact than originally proposed. We now have sophomores in quantitative analysis using the GC's.*

- *We are integrating the equipment throughout the curriculum from freshman to senior level courses. Originally, the project was proposed for upper level courses.*

- *Student laboratory involvement with the FT/IR has been more intense than originally planned in the physical chemistry and advanced inorganic courses. More laboratory time is devoted to IR studies of molecules. Additionally, a heavier introductory emphasis is planned for the course of first FT/IR contact, introductory organic chemistry.*

- *Due to student feedback the proportion of time spent in lab sessions has been increased beyond what the original proposal outlined. Students have across the board requested more time for lab sessions or extended labs. The extent to which students in experimental psychology have utilized the equipment is much greater than I would have estimated.*

- *More of the advanced mathematics courses are using the equipment, especially the geometry courses. More chemistry professors have used the equipment and have since included more graphic uses in their classes.*

- *Considerably more use of computer interfacing with chromatography in analytical courses than anticipated.*

However, about a third of the PIs who reported expansions wrote that implementation required changes and compromises which narrowed the scope of the project or changed its content:

- *The project was written by a physical chemist who had intended to incorporate use of NMR into that* *course. He has since left the university so those aspects did not get developed.*

- *Content changes almost every semester because different faculty teach the courses each year and each prefers to assign their own labs.*

- *The expected use of the instrument by faculty for classroom instruction has not entirely developed; faculty bring their classes for exercises but expect the technician to actually do the instrument work for the class.*

- *Have not integrated equipment into some courses in which we proposed to use the instruments.*

Finally, a number of grantees indicated that, in addition to its instructional use, the equipment was also being used for faculty and student research activities:

- *More use of the equipment by faculty and students working on research projects.*

- *The greatest use of the instrument has not been in class instruction but in undergraduate and graduate student research.*

- *The equipment, ultracentrifuge and liquid scintillation counter, are proving difficult to introduce into our student labs. Therefore we are using them, at present, mostly for student research projects. We are continuing to explore methods for introducing them into student labs.*

Setup Work Needed and Proportion Completed

CSIP projects require a major commitment of time and effort on the part of the PI. The average time needed to order, install, and learn to use the equipment, develop course materials, train staff, and integrate the equipment into the curriculum was 337 hours, or 42 8-hour days (Table 6-5). About 40 percent of all respondents reported that the amount of time needed to implement their projects was substantially greater than they expected when they submitted their proposals (Table 6-6).

Table 6-5. Principal investigator's report of time needed to implement CSIP project by grant year. 1985-87

Task	Grant Year			
	Total	1985	1986	1987
	Hours	Hours	Hours	Hours
Total time needed	336 6	373 7	322.7	354 7
Order, install. learn to use equipment . .	129 9	126.0	139 1	126 5
Develop course materials .	140 6	127 8	132 4	154.5
Train staff	44 1	42.4	38 5	48 7
Integrate equipment	76.6	73.0	64.4	87.7

Source: Assessment of the 1985-87 College Science Instrumentation Program. Office of Studies and Program Assessment. NSF. 1990.

Table 6-6. Principal investigator's report of time provisions for CSIP project implementation by grant year: 1985-87

Time factor	Grant year			
	Total	1985	1986	1987
Total..........	100.0%	100.0%	100.0%	100 0%
Time more than anticipated	39.5	35.6	39.6	42.2
Requested release time	23.3	19.2	25.3	25.0
Release time granted	19.2	12.5	20.9	22.8
Other provisions made	20.1	18.8	20.9	20.7

Note: Percents do not add to 100 because respondents could indicate more than one or no time factors

Source: Assessment of the 1985-87 College Science Instrumentation Program. Office of Studies and Program Assessment. NSF. 1990.

The two most time consuming tasks were ordering, installing, and learning to use the equipment, and developing course materials, each of which took an average of 17 days. Integrating the equipment into the curriculum was next most time consuming, with about 70 percent of projects reporting an average of 10 days spent on activity in this area. Half of projects reported staff training activities, which averaged six days to complete.

Less than a quarter of principal investigators requested release time to implement their projects. PIs appear to have a general idea of the effectiveness of such requests at their own institutions since 82 percent of those asking for release time received it. Many other PIs were of the opinion that such requests were a waste of time. Other provisions, which could include summer salary or the hiring of technicians, were made for about 20 percent of projects.

Although PIs are solely responsible for oversight of project implementation, the substantial involvement of other people also contributed to the timely implementation of projects. PIs reported an average of nine people involved in project setup (Table 6-7). Almost two-thirds (64%) of projects involved participation by other faculty members; more than half (56%) involved students; 43 percent involved technicians; one-third involved lab assistants; and about a quarter (27%), other university employees. Also involved (though infrequently) were: outside contractors, company representatives, vendors, and consultants.

Table 6-7 Principal investigator's report of number of people involved in CSIP project setup by grant year: 1985-87

Personnel	Grant year			
	Total	1985	1986	1987
Total mean number	8.8	9.6	8.2	8.7
PI/co-PI	1.4	1.3	1.3	1.5
Other faculty	2.4	2 5	2.5	2 4
Students	6.3	8.8	5.1	5.7
Lab assistants	2.3	2.8	1.8	2.1
Technicians	1 4	1.2	1.6	1.5
Other university employees	2.3	2.4	2.4	2.2
Outside contractors	1.8	1.7	1.7	2.0

Source Assessment of the 1985-87 College Science Instrumentation Program, Office of Studies and Program Assessment, NSF, 1990.

The setup work for most projects has been completed. About 87 percent of the work in ordering, installing, and learning to use the equipment has been done, as has 75 percent of the work in developing course materials, 79 percent of the work in training staff, and 74 percent of the work in integrating the equipment into the curriculum (Table 6-8). The proportion of work completed drops off substantially for 1987 grant year projects, where, for instance, only 65 percent of the work in developing course materials has been completed.

Table 6-8 Principal investigator's report of portion of CSIP project work completed at time of survey by grant year 1985-87

Task	Grant Year			
	Total	1985	1986	1987
Order, install, learn to use equipment	86.8%	92.8%	89.8%	80.5%
Develop course materials	74.9	86 3	77.8	64.9
Train staff	78.9	86 4	85.5	69.9
Integrate equipment	74 4	87.1	74 1	63.6

Source Assessment of the 1985-87 College Science Instrumentation Program, Office of Studies and Program Assessment, NSF, 1990

Grantee comments on factors affecting the time for project implementation generally fall into three categories. The first pertains to the acquisition and integration of the equipment itself:

- *Simply getting curriculum changes through our coordinating board {was time consuming}.*

- *Initial efforts in achieving operational status of the equipment was greater than expected. I learned both how to operate the instrument and maintain and repair it. Many experiments were developed in order to find the best ones for students and to explore the capabilities of the instrument (GC/MS).*

- *The multitude of software available took many hours to evaluate; I needed to evaluate the software in order to determine which type of computers to purchase for students (not all software is available for all computers, obviously). When I saw how much time this would take, I asked for release time (which I did not get).*

- *Installation was a major headache! It literally took months.*

- *Spent great amount of time evaluating equipment, seeking vendor support for matching funds. None were forthcoming. Learning to use the equipment took much longer than expected. University computing service supported project from start and are continuing to do so.*

- *More time in training faculty on use of HPLC than foreseen.*

- *The equipment is not reliable; when we had it set up, we had to call in the vendor several times for adjustments. It is also not easy to learn to use. Since there has been no release time for this, it has been disconnected until Summer of 1989 when I expect to have time to work with it.*

- *I simply didn't realize how much time it would take to research, order and help install, debug and implement my equipment.*

- *Learning to use the equipment was easy; integrating it into the curriculum was more difficult (we were used to the old ways!).*

- *The project became more complicated than originally proposed. Equipment purchased was more complex & greater variety of software had to be learned. Three faculty members applied for and received one month's salary each for curriculum development related to this project.*

Staff commitment and availability was a second factor affecting the timeliness of project implementation. It was frequently noted in respondent comments:

- *No release time granted by the dean.*

- *University granted release time to organize and write laboratory manual. The university provided money for maintenance of equipment.*

- *Three students were hired to help write some of the computer programs.*

- *PI was given a single course load reduction one semester to set up the lab. No help was given with the physical setup of lab. All tables, security, equipment, etc. were installed by the PI.*

- *We have received a few weeks of summer support for work on computer projects: building hardware interfaces, writing software. The support has been minimal and is not nearly enough. 90% Of the work has been on our own time.*

- *I used part of my sabbatical leave to implement the project. Also used summertime (unpaid).*

- *The PI utilized substantial amounts of his summer (and that of a student) time to do much of the initial setup work on this project.*

- *I obtained 3 course releases (one over each of three quarters) to work on the integration of the equipment into the curriculum. The hardware we purchased was more complicated than expected and the documentation was inadequate for our purposes, so the time spent was greater than anticipated.*

- *I requested and was granted a one course reduction for the 1987-88 school year. However, an unexpected change in staff cancelled those provisions.*

- *Because the ordering of equipment was complex, and because some new skills were required of me, I was unable to implement the project until I requested and was grantea a sabbatical leave for a semester.*

- *It has been very difficult to generate sufficient time, of a continuous nature, to make real progress. This problem related to departmental staffing and other major university responsibilities. Proposal for special scholarly leave time for CSIP project was not granted.*

- *One faculty member took one of the computers home and spent much extra time at home developing the necessary software.*

Finally, a few respondents cited administrative factors as affecting the implementation of their projects:

- *University regulations required that all equipment costing more than $100.00 be let out for bid. This was a very time consuming unnecessity and significantly delayed project start up.*

- *It has taken longer than expected to integrate a solid state physics lecture course with the solid state physics experiments. This delay was caused by the inability of the Mechanical Engineering and Engineering Science and Physics departments to agree who should teach the solid state physics lecture course. This issue has been decided in favor of the physics department by the administration.*

- *Extensive renovations of our science building were complete a year after we obtained our CSIP equipment. As a result, we had to install the equipment twice: once in a temporary facility and later in a permanent location.*

Kinds of Problems Encountered

Fewer than half of the PIs encountered major problems with project implementation. Overall, 44 percent mentioned major problems with their projects (Table 6-9). Problem areas most often mentioned were ordering, installing, and learning to use the equipment (21%), and maintaining the equipment (12%). In fewer than 10 percent of projects, developing course materials, training staff, integrating the equipment into the curriculum, operating the equipment, and other aspects of project implementation were mentioned as problems.

Table 6-9. Principal investigator's report of major problems encountered in CSIP project implementation by grant year: 1985-87

Problem area	Grant year			
	Total	1985	1986	1987
Total	100.0%	100.0%	100.0%	100 0%
Any problem	44 4	37.5	41.8	51 1
Ordering, installing, learning to use equipment	20 6	16.8	16.5	26.1
Developing course materials	8 0	6.7	3.3	12.0
Training staff	4.2	3 4	3.3	5 4
Integrating equipment into curriculum	7 8	8.2	7 7	7.6
Maintaining equipment	12.3	14.9	13.2	9.8
Operating equipment	6.8	4.8	7.7	7.6
Other aspects	9.2	5.3	11.0	10.9

Note: Percents do not add to 100 because respondents could indicated more than one or no major problems

Source: Assessment of the 1985-87 College Science Instrumentation Program, Office of Studies and Program Assessment, NSF, 1990.

ASSESSMENT OF THE APPLICATION PROCESS

Highlights

Most aspects of the CSIP program administration were judged favorably by both grantees and unsuccessful applicants, but the timing of announcements and the deadline for submission, and (particularly for applicants) the clarity of review feedback were identified as areas needing improvement. The primary area of concern noted by applicants was the clarity and appropriateness of the program guidelines. Additional recommendations concern-ing the value of provision for training support in grants and for provision for instrument price increases were made by PIs during site visits.

Overview

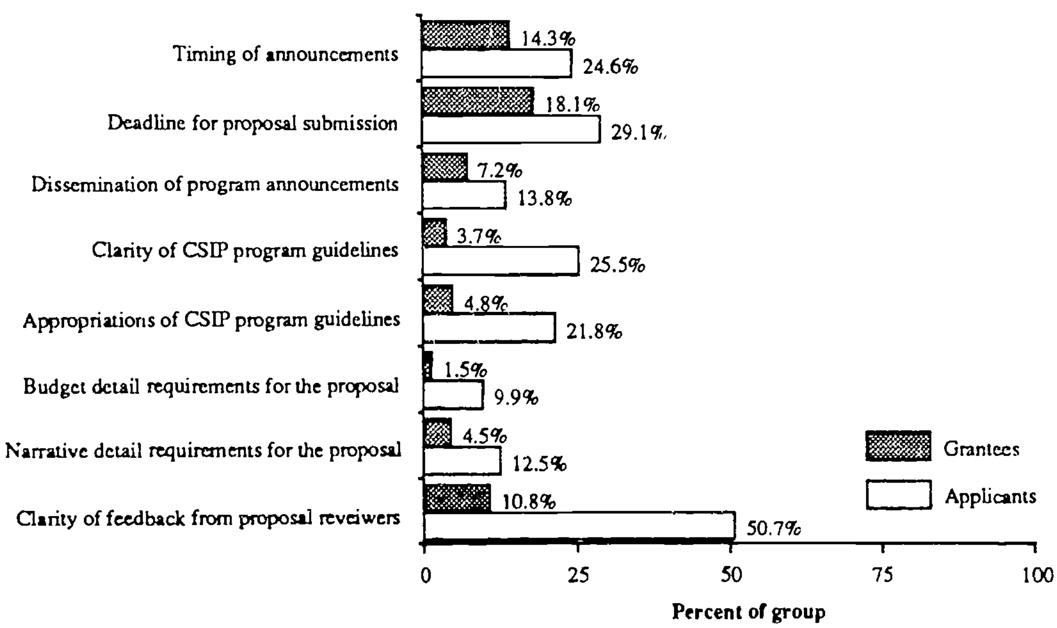
Respondents to both the grantee and unsuccessful applicant mail questionnaires were asked to rate eight aspects of CSIP program administration as adequate or needing improvement:

- Timing of announcements;
- Deadline for proposal submission;
- Dissemination of program announcements;
- Clarity of CSIP program guidelines;
- Appropriateness of CSIP program guidelines;
- Budget detail requirements for the proposal;
- Narrative detail requirements for the proposal; and
- Clarity of feedback from proposal review.

Supplementing the questionnaire data are data from responses to a question asked during site visits about ways the PI thought the CSIP program could be improved.

The most striking finding of the analysis of the questionnaire data is that grantees and unsuccessful applicants have few criticisms of the CSIP administration process. Grantees, on average, assigned less than one negative rating for the eight elements, and no single aspect of program administration received a negative rating from as many as one-fifth of grantees. Unsuccessful applicants assigned less than two negative ratings each, but five aspects received negative ratings from more than one-fifth of that group. *Clarity of review feedback* was by far the most criticized aspect, with over 50 percent of unsuccessful applicants rating this as in need of improvement (Figure 7-1).

Figure 7-1: Elements of grant process and program needing improvement



Those respondents who rated aspects as being in need of improvement were asked to provide explanations or recommendations based on their experience with the CSIP program. Although most grantees and unsuccessful applicants did not see a great need for improvement, the inputs of those who saw such a need provide important information. These explanatory comments give a clear view of the perceptions of CSIP's weak points by those who submit proposals, and the ways they would like to see the program change. In the remainder of this chapter responses to each aspect will be discussed, and statements from grantees and unsuccessful applicants will be presented.

Timing of CSIP Program Announcements and Deadline for Proposal Submission

Approximately one in seven grantees and one in four unsuccessful applicants saw a need for improvement in the timing of announcements. There were slightly more negative responses to the deadline for proposal submission area, but responses follow a similar pattern. Negative responses were given by 18 percent of grantees and 30 percent of unsuccessful applicants.

Written comments from grantees and unsuccessful applicants note very similar problems: respondents reported that the time between the announcement and the submission date is inadequate, and the submission deadline fell at a bad part of the academic year.

From Grantees

- *Three months should be allowed between these dates {announcements and deadlines} for continuing programs; more time if there is a substantial change in announcement from previous years.*

- *The old January deadline was a problem. The new deadline is even tougher. Couldn't it be moved to spring?*

- *Not enough time is allowed between program announcement and proposal submission deadline. (I suspect this may be a problem for those unfamiliar with the program.)*

- *The early November deadline with early fall announcement is a time-problem for those who are not aware that one must anticipate this deadline at least 6 months in advance.*

From Unsuccessful Applicants

- *Department chairpersons usually receive the announcements 6-8 weeks prior to the deadline. This does not allow sufficient time for a faculty member or committee, with many other duties, to analyze needs in accordance with the guidelines, gather data, write the proposal, secure the appropriate university approvals and signatures prior to the deadline.*

- *Because of academic schedules, it would be useful to have the summer to prepare proposals. A separate, standard form could be used to gather information about the institution and department. Allow the narrative to focus only on the specific instrument proposal.*

- *In the case of small institutions, the faculty member alone must prepare the proposal. We do not generally have a number of prepared proposals to draw from. We need time.*

- *By the time I get an announcement in the mail, there is, at most, 1 month before the deadline. This is not enough time.*

Dissemination of CSIP Program Announcements

Only 7 percent of grantees and 14 percent of unsuccessful applicants found problems with the dissemination of announcements. Again, the focus of comments for the two groups was similar, centering on the difficulty in receiving announcements, and the suggestion to mail them directly to departments rather than to development offices was made frequently.

From Grantees

- *Finding out about grant funding is difficult. Seems to be a problem with mailing lists. Perhaps would be better to send to faculty members or department heads than to development officers.*

- *Small schools have less contact with NSF and tend to not hear about new programs as quickly. Information did not come to me. Our institution does not receive all announcements. I had to seek the information.*

- *Prior applicants should get new guidelines automatically.*

- *Materials are not directly forwarded to department heads, but go to the college administration. Send directly to departments as well as research office.*

From Unsuccessful Applicants

- *Some years I have received announcements, but in other years I have not.*

- *I called several time before receiving an application packet.*

- *Mail announcements directly to previous applicants, especially first-timers.*

- *We have had to call NSF to get a copy of the guidelines. Guidelines should be out by August to allow adequate time to prepare a proposal.*

Clarity and Appropriateness of CSIP Program Guidelines

Only 4 percent of grantees felt that CSIP guidelines were not sufficiently clear, and only 5 percent felt they were not appropriate. Many more unsuccessful applicants felt this way: 26 percent felt they were not clear, and 22 percent felt they were not appropriate. This finding is consistent with the analysis in Chapter 5 of this report, which found that proposals that more consistently promote CSIP goals have a greater chance of funding. Understanding and following the program guidelines is probably very important to writing a successful proposal.

Recommendations from grantees and unsuccessful applicants focus mainly on specifying/changing the kinds of equipment/projects that the CSIP program will fund, and the types of institutions that should be given funding priority.

From Grantees

- *Guidelines push department towards equipment it probably does not need. Distorts purchases for other areas of the department.*

- *It is not uncommon to find conflicting statements within the guidelines.*

- *Guidelines are OK for someone who has some experience but are not of great assistance to the first time grant writer, especially at small institutions where there is no grants office.*

- *Guidelines do not correspond very well to guidelines provided by NSF officials informally by phone. We would probably not have been successful if we had relied on only the vague written guidelines.*

- *A proposal shouldn't have to be based on a sensational new idea to be funded. Basic equipment needs are obvious, and a thorough proposal explaining how instrumentation will be used, even if nothing "new and exciting" is being done is still worthy.*

- *I have on several occasions applied for CSIP grants. When I have not been successful a common response is that the proposed project is too sophisticated for undergraduates. I wish some policy could be developed so that decisions made by reviewers would not be so conservative about new innovative approaches.*

From Unsuccessful Applicants

- *Guidelines need to define upgrading -- does it mean model of equipment or upgrading of lab content of exercise?*

- *Guidelines did not make it clear the kind of equipment (student microscopes) I was requesting would be more appropriately funded by my university.*

- *Proposal writers need a clearer picture of the criteria used by the proposal reviewers.*

- *Guidelines need to be more specific as to what is eligible, e.g., if routine, standard equipment isn't eligible -- then the guidelines should state that only expensive or exotic equipment is eligible.*

- *I feel that there is often a hidden agenda in the evaluation of proposals and that the real criteria for evaluation should be published in the guidelines. Departments with no experience of success can spend enormous effort with little chance of success unless they got input from persons with a history of success.*

- *The guidelines do not state that numerical student impact will be a major factor in awarding grants or that reviewers should consider it. That was the only negative comment received on my proposal and I saw it was not funded. Guidelines must be improved.*

- *I sense that the focus is to make good programs excellent -- we need help to get from mediocre to adequate.*

- *As long as the equipment is primarily used for undergraduates a large university can apply for the program. That's simply not fair to small, undergraduate, teaching schools. We cannot effectively compete with the large schools!*

- *{CSIP} seems to indicate a bias toward computer related projects at the expense of standard or routine engineering equipment in short supply.*

- *Specify that "creative" uses of equipment are requested -- not just instrumentation to strengthen one's curriculum.*

Budget and Narrative Detail Requirements for the Proposal

Few grantees (2% and 4%, respectively) felt that budget or narrative detail requirements for the proposal were a problem. More unsuccessful applicants (10% and 13%, respectively) thought these areas needed improvement, but these aspects were also the ones that concerned unsuccessful applicants least. Few respondents wrote on this topic. A rare comment comes from a grantee:

- *Very detailed budget required, but with inflation PI loses much buying power.*

Clarity of Feedback from Proposal Reviewers

Opinions about the clarity of feedback from proposal reviewers have the widest disparity between grantees and unsuccessful applicants (11% negative versus 51% negative, respectively). This aspect has the third highest negative rating by grantees, but has by far the highest negative rating by unsuccessful applicants (more than 20% higher than the next highest aspect). The concentration of unsuccessful applicants on criticism in this category merits careful consideration, especially since their narrative statements do not seem to be of the "sour grapes" variety. Most were thoughtfully expressed and lacking in bitterness. Both grantees and unsuccessful applicants focused on the types of feedback they would like to receive, particularly with regard to consistency of comments by reviewers, and how reviewers should be selected.

From Grantees

- *Most unsuccessful proposals are resubmitted; comments on how proposals could be strengthened should be emphasized.*

- *The reviewers should be selected with more care, and proposals should be reviewed by reviewers from similar institutions. Hot shots in research institutions will not usually see the validity of need for certain equipment items needed by a small teaching school when they themselves take such items for granted.*

- *The consistency of reviewers is a problem. The aspects of my proposal which the first reviewers criticized, were praised the next year when my proposal was funded.*

- *First submitted -- not funded -- excellent review. Same grant - resubmitted following year -- terrible reviews and funded (no consistency in process).*

- *First time we were turned down and found reviewers comments very general. The more detailed the reviewers comments, the more helpful it is to prepare for resubmission.*

From Unsuccessful Applicants

- *Reviewers need to be consistent; it was obvious to us one reviewer did not appear to have read the proposal, other reviewers comments contradicted one another. One would praise the grant for an attempt at a specific objective while another complained that the same objective was not tried.*

- *The comments in the first review suggested specific areas where changes might make the proposal more acceptable. However, the second set of reviewers (the second year) criticized the proposal primarily for the things that were changed to respond to the first review comments. The guidelines and review process should be objective enough that this yo-yo-ing would not occur.*

- *There is the usual problem th : one cannot respond to criticism the year it is offered. The next year completely new reviewers may be reading the grant. Can one get a list of what equipment was funded for what project as a guideline?*

- *For CSIP proposals in engineering, it is essential to include practicing engineers from private sector to ensure that the proposed instrumentation will promote the current professional practice.*

- *From my point of view, it seemed as though the reviewers were more interested in the existing equipment at the institution and the background of the applicant than the quality of the proposal.*

- *It appears that most of the scientists reviewing the proposals have never worked in any segment except the educational segment. People with such a limited background or experience have limited knowledge in understanding what graduates need to be adequately prepared in entering the industrial world. They fail to view proposals and evaluate them properly if the proposals do not address the request of some large and expensive piece of equipment that is usually designed for research rather than for teaching students the scientific skills of instrumentation and technology needed for adequate professional performance in the industrial and governmental segments of society.*

- *Reviewers did not react to my plan with respect to the goals, but rather their preconceived ideas of what should be done.*

- *It is imperative that an archaeological proposal not be sent to anybody in social sciences, since disciplines under the category of social science are totally unfamiliar with archaeology. Only archaeologists should review archaeological proposals, not philosophers, psychologists or language teachers.*

- *Would like a variety of reviewers. (1) from different regions, (2) from small colleges.*

Viewpoints Expressed During Site Visits

During site visits PIs of operating projects were asked for suggestions about how the CSIP program might be improved. Several of their recommendations are not seen in data from the mail questionnaires, including allowing provision for training support and for price increases in instruments:

- *PI feels that NSF should consider small training grants to enable PI's and other staff to learn to use the equipment (perhaps the year after it is acquired).*

- *Suggests that NSF consider allowing training costs on sophisticated equipment as an allowable one-time part of the budget. {The PI and co-PI} would both like to see an instrument specific (NMR in this case) newsletter with lab manuals, etc., to reduce duplication work.*

- *Project got caught in major marketing/price change that resulted in $15,000 higher cost to college than anticipated. This might have been avoided by faster turnaround between application, award.*

- *The PI raised the issue of the handling of price increases in equipment which may occur over the review period. While recognizing that the review process requires sufficient time, he suggested that some provision for legitimate price increase be included in the budget.*

APPENDIX A

SITE VISIT CONSULTANTS

CSIP SITE VISIT CONSULTANTS

Dr. Charles Alexander
Department of Electrical Engineering
Temple University

Dr. Richard Blatchly
Chemistry Department
Williams College

Dr. Joanne Cameron
Department of Cell and Structural Biology
University of Illinois - Urbana

Dr. Joseph T. Chowattukunnel
Department of Biology
Indiana University - South Bend

Dean James Diefenderfer
California State University - Fullerton

Dr. Norman Henderson
Severance Laboratory
Oberlin College

Dr. Timothy Keiderling
Department of Chemistry
University of Illinois - Chicago

Dr. J. H. Kreiner, Chair
Department of Mechanical Engineering
California State University - Fullerton

Dr. Karen W. Morse, Dean
College of Science
Utah State University

Dr. Steven Murray
Department of Biology
California State University - Fullerton

Dr. Edwin Robinson
Department of Geological Sciences
Virginia Polytechnic Institute

Dr. Paul Schatz
Department of Chemistry
University of Wisconsin - Madison

Dr. Herbert Silber
Department of Chemistry
San Jose State University

Dr. Donald Sloan
Department of Chemistry
CCNY

Dr. Bruce Thomas
Department of Physics and Astronomy
Carleton College

Dr. Reed Warren
Department of Biology
Utah State University

Dr. Janice Woodall
Southern Union State Junior College

Dr. Sandra Yorka
Department of Physics
Denison University

PRETEST SITE VISIT SCIENTISITS/CONSULTANTS

Dr. Charles Detwiler
Department of Biology
Houghton College

Dr. Jean Rogers
Department of Computer Science
Stanford University

Dr. Dennis Steele
Department of Computer Science
University of Wyoming

Dr. Robert Ziller
Department of Psychology
University of Florida

APPENDIX B

QUESTIONNAIRES (GRANTEES AND UNSUCCESSFUL APPLICANTS)

AND SITE VISIT REPORT FORM

OMB # 3145-0113
Expires 4/89

ASSESSMENT OF THE COLLEGE SCIENCE INSTRUMENTATION PROGRAM GRANTEE QUESTIONNAIRE

National Science Foundation

The National Science Foundation is conducting an assessment of the College Science Instrumentation Program (CSIP). The purpose of this survey is to determine the impact of CSIP on the participating institutions, their students, and on efforts to improve undergraduate science instruction.

We ask that the requested information be obtained from the current principal investigator, or, if this is not possible, from the person who is most knowledgeable about the history and current status of the project. Your name and address and the CSIP project title and year of project from the original proposal appear below. Please correct the label if any of the information is incorrect.

Where exact cost (or other) data are not available, estimates are acceptable. (Your estimates will be better than ours.)

All information you provide is confidential and will be published only in aggregate form. Your response, though important for an accurate assessment, is voluntary, and failure to provide some or all of the information will in no way affect you or your institution. This information is solicited under the authority of the National Science Foundation Act of 1950, as amended.

Please return this form by December 22. Your cooperation in returning the survey questionnaire promptly is essential to the timely completion of the assessment. Please return the completed survey to:

WESTAT, INC.
1650 Research Blvd
Rockville, MD 20850

If you have any questions regarding this survey, please contact Ms. Carin Celebuski at Westat's toll-free number 800/937-8281, or contact Mr. David Florio of NSF at 202/357-7425.

Public reporting burden for this collection of information is estimated to average 35 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to:

Herman G. Fleming
Clearance Officer - Room 208
Division of Personnel and Management
National Science Foundation
Washington, D.C. 20550

and to

Office of Management and Budget
Paperwork and Reduction Project (3145-0113)
Washington, D.C., 20503

I. PROGRESS

This first section, questions 1 through 9, will gather information about the progress, problems, and current status of your CSIP project. NSF will use this information to see how its programs might be made more responsive to the needs of institutions like yours. Later sections of this questionnaire will deal with project finances, impacts, and demographics.

1. Please check the item below that best describes your project in terms of equipment, course materials and student exposure.

☐	Not yet operational:	Equipment not yet purchased **OR** Equipment not yet installed **OR** Course materials not yet developed
☐	Partly operational:	Most equipment purchased and installed **BUT** Course materials not yet fully developed **OR** Untested with students
☐	Mostly operational:	Most equipment purchased and installed **AND** Most course materials developed **BUT** Not yet fully tested with students
☐	Fully operational:	Most or all equipment purchased and installed **AND** Most or all course materials developed **AND** Fully in use with students

2. If your CSIP project is not yet fully operational, please estimate how long it will take to become fully operational.

_________ MONTHS

3. Please assess your progress to date in implementing your CSIP project.

- ☐ Ahead of schedule
- ☐ On schedule
- ☐ Behind schedule

Questions 4 and 5 will aid in assessing the amount of change projects have undergone between proposal and implementation, and the reasons for changes.

4. Since your proposal, have there been changes in the equipment ordered or planned for your CSIP project? Check the item below that best describes your equipment situation. (A change in vendor does not constitute a substantive change.)

- ☐ Entirely or mostly as proposed
- ☐ Different equipment but functionally equivalent to that proposed
- ☐ Same equipment but serving a different purpose on the project
- ☐ Equipment and its function substantially different than proposed

Please explain any changes: ____

____

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____

5. Aside from changes in equipment, have the following aspects of your project evolved or been modified in substantial ways since the award was made?

		YES	NO
a.	Curriculum	☐	☐
b.	Format	☐	☐
c.	Content	☐	☐
d.	Audience	☐	☐
e.	Course level	☐	☐
f.	Other (SPECIFY)____________________	☐	☐

g. Please elaborate on "YES" answers to 5a through 5f.

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6. Please indicate how much time has been spent (or will be spent) on the following setup tasks for your CSIP project, and the current status of each.

	NOT APPLICABLE	APPROXIMATE HOURS FOR TASK	PERCENT OF TASK COMPLETE
a. Ordering, installing and learning to use the equipment		________	________%
b. Developing course materials (e.g., outlines, syllabi, lab manuals, lab experiments)	☐	________	________%
c. Training staff (e.g., technicians, lab monitors, lab assistants)	☐	________	________%
d. Integrating the equipment into the curriculum.........................	☐	________	________%

7. How many of each of the following categories of people were (or will be) involved in the setup work for the project? (IF NONE, WRITE IN '0').

	NUMBER
a. P.I./Co-P.I.'s	________
b. Other faculty	________
c. Students	________
d. Lab assistants	________
e. Technicians	________
f. Other university employees	________
g. Outside contractors	________
h. Other (SPECIFY) ______________________	________

8. The following questions ask about where the time for project implementation came from, or will come from.

		YES	NO
a.	Was the amount of time it has taken (or is taking) to implement your project substantially greater than the amount of time you had expected when you submitted your CSIP proposal?	☐	☐
b.	Did you or other faculty involved in the project request any release time from regular faculty duties to do the work necessary to implement the project?	☐	☐
c.	Was any release time granted?	☐	☐
d.	Were any other provisions, besides release time (e.g., summer salary, hiring of technicians), made to aid in implementing the project?	☐	☐

e. Please elaborate on "YES" responses to 8a through 8d.

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9. Have you encountered any major problems in the following areas with regard to your project?

		YES	NO
a.	Ordering, installing and learning to use the equipment	☐	☐
b.	Developing course materials	☐	☐
c.	Training staff	☐	☐
d.	Integrating the equipment into the curriculum	☐	☐
e.	Maintaining the equipment	☐	☐
f.	Operating the equipment	☐	☐
g.	Other aspects of project implementation	☐	☐

h. Please elaborate on "YES" answers to 9a through 9g.

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II. RESOURCES

The CSIP program seeks to encourage use of CSIP funds as "seed money" for more extensive equipment funding efforts. Your responses to questions 10 through 13 will help to illuminate the nature and extent of this hoped-for "multiplier effect" of CSIP grant funds. Careful attention on your part to identification of all ways in which the CSIP project may have stimulated acquisition of additional equipment and other resources is appreciated. NSF is also interested in learning about the "hidden costs" of implementation of CSIP projects, their impact on institutions, and their policy implications.

Questions 10 and 11 address several kinds of multiplier effects. Question 12 asks about hidden costs associated with CSIP project implementation, and Question 13 concerns the timing of availability of matching institutional funds.

10. Please describe the funding sources for your project (actual or pending).

a. How much money did NSF contribute to your CSIP project? $________________

b. What are the sources and amounts of matching funds for equipment purchases? (Total should equal or exceed 10a above).

1. Institution funds $________________

2. Other (SPECIFY)________________________

________________________ $________________

c. Occasionally, vendors, manufacturers or others donate equipment, or provide discounts over and above the amount of required match. Has this happened in your project? If so, please provide the type and approximate dollar values of each in-kind contribution of equipment. (Include vendor/manufacturer upgrades; add-ons; and discounts, if above the standard academic discount).

1. "Deep" discounts (above standard discounts) $________________

2. Vendor upgrade or add-on $________________

3. Other sources (SPECIFY)________________ $________________

d. Sometimes it is necessary, because of price changes, etc., to spend more than originally budgeted to purchase the proposed equipment. If this has been the case in your project, please provide the sources and dollar amounts for equipment purchases in excess of the required match.

1. Check if not applicable ☐

2. Institution funds $________________

3. Other (SPECIFY)________________________ $________________

e. Often, the "seed" money provided by CSIP and matching funds for projects has a "multiplier effect," attracting further equipment or other resources to a program, beyond the original project. Has this happened with your project? If so, please assign a total dollar value. (Do not include equipment already enumerated in b, c, or d above.)

1. Check if not applicable ☐
2. Additional equipment? $________
3. Other additional resources? $________
4. Please describe the nature of the expansion and indicate the source(s) of its funding support.

____
____
____
____
____

11. As a result of your CSIP project, have you received additional space?

☐ No
☐ Yes: ________ square feet

12. NSF funding for CSIP projects does not cover all costs associated with project implementation. Please identify any "hidden costs" associated with project implementation.

a. Facility renovation and equipment installation.

____
____ $________

b. Annual cost for supplies, maintenance, and operating expenses.

1. Supplies and utilities $________
2. Maintenance $________
3. Pro-rated salaries (e.g., faculty, technicians, graduate students, release-time) $________

13. How long after your CSIP grant was awarded did the matching funds become available to you?

☐ Immediately
☐ At beginning of institution's next fiscal year
☐ Other (PLEASE EXPLAIN)

____
____
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III. IMPACTS

In creating the CSIP program, NSF anticipated that the projects would have an impact on faculty and on institutions themselves, as well as on the undergraduates who are its primary focus. Questions 14 through 22 ask about the impacts your project has had or is expected to have in the future. NSF is particularly interested in any information you can provide about impacts that increase the sharing of ideas, dissemination of outcomes, and expansion of equipment use beyond the scope of the original project.

14. Please assess your success to date in achieving the goals of your CSIP project.

- ☐ Highly successful
- ☐ Moderately successful
- ☐ Other (SPECIFY)____

15. Please check each of the CSIP goals listed below that your project exemplifies.

- ☐ Introduction of modern instruments to improve the experiences of undergraduate students in science and engineering courses, laboratories and field work
- ☐ Interfacing of computers with scientific instrumentation and other appropriate uses of current technology in science and engineering instruction
- ☐ Development of new ways of using instrumentation to extend instructional capabilities
- ☐ Establishment of equipment sharing capability via consortia or centers

IF YOU ANSWERED, IN RESPONSE TO QUESTION 1, THAT YOUR PROJECT IS NOT OPERATIONAL OR IS ONLY PARTLY OPERATIONAL AT THIS TIME, PLEASE SKIP NOW TO QUESTION 22. OTHERWISE (IF YOUR PROJECT IS MOSTLY OR FULLY OPERATIONAL), CONTINUE WITH QUESTION 16.

16. Has your CSIP project had any of the following impacts?

	YES	NO
a. Improved the curriculum	☐	☐
b. Benefitted the faculty	☐	☐
c. Produced products that are transferrable to other institutic ns	☐	☐
d. Other (SPECIFY)__________	☐	☐

e. Please elaborate on "YES" answers to 16a through 16d.

17. Have you gotten any feedback on the value of your project from any of the following?

	YES	NO
a. Students	☐	☐
b. Other faculty from your institution	☐	☐
c. Administration from your institution	☐	☐
d. Faculty or administration from other institutions	☐	☐

e. Please elaborate on "YES" answers to 17a through 17d.

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18. Have you noted any positive impacts of your project on students in the area of:

		YES	NO
a.	skills?	☐	☐
b.	conceptual or intellectual development?	☐	☐
c.	motivation or attitudes?	☐	☐
d.	grades?	☐	☐
e.	improved attendance?	☐	☐
f.	increased enrollments?	☐	☐
g.	student presentations or papers?	☐	☐
h.	career choices?	☐	☐
i.	other? (Specify)	☐	☐

j. Please elaborate on "YES" answers to 18a through 18i.

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19. The following questions refer to the equipment purchased (or expected to be purchased) with your CSIP grant and matching funds for the first full year of operations or the anticipated first full year of operations, depending on the current status of your project.

Estimates based on: ☐ Actual Full Year
☐ Anticipated Full Year

	TOTAL NUMBER OF PERSONS	AVERAGE HOURS OF USE PER PERSON
a. Altogether, how many faculty members (will) use the equipment?	______	______
1. For undergraduate classroom or lab instruction?	______	______
2. For their own research?	______	______
b. Altogether, how many undergraduates (will) use the equipment?	______	______
1. In lab courses?	______	______
2. In lecture classes?	______	______
3. For independent study?	______	______
4. For student research?	______	______
5. For other purposes? (SPECIFY)______________	______	______

20. Have you or others found uses for your equipment that were not identified in your proposal or in addition to CSIP project activities?

- ☐ No
- ☐ Yes (ELABORATE BELOW)

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21. The following questions are asked to give us some indication of the extent to which results of CSIP projects are being shared, and in which circumstances sharing may be appropriate.

		YES	NO
a.	Are there elements of your project that might interest others outside your institution?	☐	☐
b.	Have you received inquiries about your project from persons outside your institution?	☐	☐
c.	Have you or others shared information on your CSIP project in any of the following ways?		
	1. Presentations	☐	☐
	2. Publications	☐	☐
	3. Shared course materials	☐	☐
	4. Collegial discussions	☐	☐
	5. Responses to inquiries	☐	☐
	6. Other (SPECIFY) ______	☐	☐
d.	Has information you received about other CSIP projects been helpful to you in any way?	☐	☐
e.	Have any arrangements been made to share the equipment with other institutions?	☐	☐

f. Please elaborate on "YES" answers to 21a through 21e.

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IV. DEMOGRAPHIC AND INSTITUTIONAL INFORMATION

To provide a context for analysis of the progress, financial, and impact information, NSF needs specific information about you, your department, your institution, and your undergraduate population. In addition, in order to best serve CSIP-eligible institutions in the future, it will be helpful to know about your past experience with similar projects and proposals.

22. Please provide the following information about yourself.

a. What is your highest degree? ____________________

b. In what year did you receive this degree? ____________________

c. How many years have you been on the faculty of your current institution? ____________________

			AT TIME OF PROPOSAL	CURRENTLY
d.	What was/is your tit e?	Full Professor	☐	☐
		Associate Professor	☐	☐
		Assistant Professor	☐	☐
		Other (SPECIFY) __________	☐	☐
e.	What was/is your tenure status?	Tenured	☐	☐
		Untenured	☐	☐
		Not Tenure Track	☐	☐
f.	What was/is your teaching load, (average number of teaching hours per week).		______	______

23. Please describe the faculty currently in the department where you have your primary appointment.

		NUMBER
a.	Number of faculty members	________
b.	Number full-time	________
	1. Number with Ph.D. as highest degree	________
	2. Number with Masters as highest degree	________
	3. Number with Bachelors as highest degree	________
c.	Number part-time	________

24. Please describe the student enrollment in the department where you have your primary appointment.

		NUMBER
a.	Number of majors graduating per year (averaged over the last three years)	______
b.	Total departmental undergraduate opening fall enrollment in all courses in 1987	______

25. Of the undergraduates affected by your project during its first full year of operation (as reported in Question 19b) approximately what percent were (or are expected to be):

		PERCENT (round to nearest 10%)
a.	female?	______%
b.	ethnic or racial minorities?*	______%
c.	handicapped?	______%
d.	freshmen or sophomores?	______%
e.	upper division education majors?	______%
f.	upper division science** majors?	______%

*Ethnic or racial minorities refers to students who are non-white or are of Hispanic origin.

**Math, Life Sciences, Physical Sciences, Computer Science, Engineering, Social Science, or Psychology.

26. What percent of the undergraduate majors in your department will do the following after graduation.

Check whether: ☐ Responses are based on records
☐ Responses are estimates, based on experience

		PERCENT
a.	go to graduate school in a related field?	______%
b.	go to medical or other professional school?	______%
c.	work at a related job in industry or the military?	______%
d.	work as a teacher in a related field?	______%
e.	other (SPECIFY)______	______%

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V. THE CSIP APPLICATION PROCESS

27. Please give your reaction to the following elements of the grant process and program, and provide your recommendations for those areas which need improvement.

		ADEQUATE	NEEDS IMPROVEMENT
a.	Timing of announcements	☐	☐
b.	Time to respond	☐	☐
c.	Method of dissemination of CSIP announcements	☐	☐
d.	Clarity of guidelines	☐	☐
e.	Appropriateness of guidelines	☐	☐
f.	Budget detail requirements	☐	☐
g.	Narrative detail requirements	☐	☐
h.	Clarity of review feedback	☐	☐
i.	Other (SPECIFY)__________	☐	☐

j. Please elaborate, particularly on those areas in need of improvement.

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28. How did you become actively aware of the CSIP grant program? (CHECK ALL THAT APPLY)

- ☐ From an NSF publication
- ☐ From a notice in a professional journal
- ☐ From a notice in a professional association newsletter, or at an association meeting
- ☐ From your college administration or department head
- ☐ Other (SPECIFY) ____________________

29. Who wrote the grant proposal? (CHECK ONLY ONE)

- ☐ Yourself
- ☐ Department committee
- ☐ Other (SPECIFY) ____________________

30. Who initiated the development of your CSIP grant application? (CHECK ONLY ONE)

- ☐ Yourself
- ☐ College administration
- ☐ Department head
- ☐ Other (SPECIFY) ____________________

31. Did you apply for funds for this or a closely related project prior to your successful application for CSIP funding? (CHECK ALL THAT APPLY)

- ☐ No (SKIP TO QUESTION 34)
- ☐ Yes, from CSIP, earlier year
- ☐ Yes, from other source (SPECIFY) ____________________

32. Did you obtain funding?

- ☐ No
- ☐ Yes (ELABORATE BELOW)

____

____

____

33. If you previously applied to CSIP, did feedback provided by reviewers aid you in revising the proposal for resubmission? Please elaborate.

____

____

____

34. In the year you received your award, were the comments from the proposal reviewers useful?

- ☐ No
- ☐ Yes (SPECIFY) ____________________

35. Prior to submitting the proposal for your CSIP project had you successfully obtained grant funding for any other project(s)? (CHECK ALL THAT APPLY)

- ☐ No
- ☐ Yes, Federal source
- ☐ Yes, other source

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How long did it take to fill out this form?

______________ Minutes

Please provide your name and phone number, in case additional information or clarification is needed.

Name: ______________________________

Phone Number: ________/______________

OMB # 3145-0113
Expires 4/89

ASSESSMENT OF THE COLLEGE SCIENCE INSTRUMENTATION PROGRAM APPLICANT QUESTIONNAIRE

National Science Foundation

The National Science Foundation is conducting an assessment of the College Science Instrumentation Program (CSIP). The purpose of this survey is to determine the impact of CSIP as well as to find ways that the grant program might be improved. To that end we are surveying both grantees and applicants whose proposals were not funded by CSIP.

We ask that the requested information be obtained from the proposed principal investigator whose name and address, and proposed CSIP project title and year of proposal, appear below. Please correct the label if any of the information is incorrect.

Where exact cost (or other) data are not available, estimates are acceptable. (Your estimates will be better than ours.)

All information you provide is confidential and will be published only in aggregate form. Your response, though important for an accurate assessment, is voluntary and failure to provide some or all of the information will in no way affect you or your institution. This information is solicited under the authority of the National Science Foundation Act of 1950, as amended.

Please return this form by December 22. Your cooperation in returning the survey questionnaire promptly is essential to the timely completion of the assessment. Please return the completed survey to:

WESTAT, INC.
1650 Research Blvd
Rockville, MD 20850

If you have any questions regarding this survey, please contact Ms. Carin Celebuski at Westat's toll-free number 800/937-8281, or contact Mr. David Florio of NSF at 202/357-7425.

Public reporting burden for this collection of information is estimated to average 15 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to:

Herman G. Fleming
Clearance Officer - Room 208
Division of Personnel and Management
National Science Foundation
Washington, D.C. 20550

and to

Office of Management and Budget
Paperwork and Reduction Project (3145-0113)
Washington, D.C., 20503

I. THE CSIP APPLICATION PROCESS

NSF is interested in learning as much as possible about reactions to the CSIP application process, the prior funding experience of applicants, and the nature of the proposal process, as well as in hearing any specific recommendations which might improve the CSIP program. Respondents are urged to use as many extra pages as necessary to elaborate fully on aspects of the proposal process which are in need of improvement. NSF will use this information to examine how its programs might be made more responsive to the needs of institutions like yours.

Later sections of this questionnaire deal with outcomes of your CSIP application and with demographic information to be used for contextual analysis of CSIP study data.

1. How did you become actively aware of the CSIP grant program? (CHECK ALL THAT APPLY)

- ☐ From an NSF publication
- ☐ From a notice in a professional journal
- ☐ From a notice in a professional association newsletter, or at an association meeting
- ☐ From your college administration or department head
- ☐ Other (SPECIFY) ______________________________

2. Who wrote the grant proposal? (CHECK ONLY ONE)

- ☐ Yourself
- ☐ Department committee
- ☐ Other (SPECIFY) ______________________________

3. Who initiated the development of your CSIP grant application? (CHECK ONLY ONE)

- ☐ Yourself
- ☐ College administration
- ☐ Department head
- ☐ Other (SPECIFY) ______________________________

4. Did you apply for funds for this or a closely related project <u>prior to</u> your application for CSIP funding?

- ☐ No (SKIP TO QUESTION 6)
- ☐ Yes (SPECIFY SOURCE)______________________________

5. Did you obtain any funding at that time?

- ☐ No
- ☐ Yes (ELABORATE BELOW)

____

____

____

6. Prior to submitting the CSIP proposal had you successfully obtained grant funding for any other project(s)? (CHECK ALL THAT APPLY)

☐ No

☐ Yes, Federal source

☐ Yes, other source

7. Please check each of the CSIP goals listed below that your proposed project exemplified.

☐ Introduction of modern instruments to improve the experiences of undergraduate students in science and engineering courses, laboratories and field work

☐ Interfacing of computers with scientific instrumentation and other appropriate uses of current technology in science and engineering instruction

☐ Development of new ways of using instrumentation to extend instructional capabilities

☐ Establishment of equipment sharing capability via consortia or centers

8. Did you find the CSIP reviewer's comments on your proposal useful in any way?

☐ No

☐ Yes (EXPLAIN HOW)

____

____

____

9. Please give your reaction to the following elements of the grant process and program, and provide your recommendations on those areas which need improvement.

		ADEQUATE	NEEDS IMPROVEMENT
a.	Timing of announcements	☐	☐
b.	Time to respond	☐	☐
c.	Method of dissemination of CSIP announcements	☐	☐
d.	Clarity of guidelines	☐	☐
e.	Appropriateness of guidelines	☐	☐
f.	Budget detail requirements	☐	☐
g.	Narrative detail requirements	☐	☐
h.	Clarity of review feedback	☐	☐
i.	Other (SPECIFY)	☐	☐

j. Please elaborate, particularly on those areas in need of improvement.

____

____

____

II. OUTCOMES OF YOUR CSIP APPLICATION

NSF is interested in whether unsuccessful CSIP applicants pursued other funding sources (either institutional or external) for their equipment, whether they were successful in funding it, and whether the CSIP application process itself had any positive or negative effects on the school, the department, or individuals. NSF believes that increased understanding of these outcomes and effects will enable it to improve policies and procedures and urges careful consideration of responses and complete answers to open-ended questions. If additional space is needed, please use the space provided in question 20.

10. Since your CSIP grant application, have any other efforts been made (by you or others) to obtain funding support for your proposed project?

☐ No (SKIP TO QUESTION 12)

☐ Yes (PLEASE DESCRIBE)

____

____

____

11. Has any funding support been obtained for your proposed project?

☐ No

☐ Yes (PLEASE DESCRIBE)

____

____

____

12. Have you been able to obtain any of the instruments (or equivalents) that you requested in your CSIP application?

☐ No (SKIP TO QUESTION 15)

☐ Yes

13. Approximately what percent of your original CSIP budget request do the obtained instruments represent?

________________ Percent

(If percent is unknown, please indicate the combined purchase price of the obtained instruments: $________________)

14. What funding sources contributed to the acquisition of these instruments. (CHECK ALL THAT APPLY)

☐ Department funds

☐ Other college/university funds

☐ Federal sources (SPECIFY)________________________

☐ Business/Industry

☐ Other (SPECIFY)________________________

15. Are any further efforts to obtain funding support for this project anticipated?

☐ No

☐ Yes (PLEASE DESCRIBE)

16. Did the development of your CSIP proposal have any direct or indirect positive effects?

☐ No

☐ Yes (PLEASE ELABORATE)

17. Did the unsuccessful outcome of your CSIP grant application have any direct or indirect negative effects on the school, the department or on individual students or faculty?

☐ No

☐ Yes (PLEASE ELABORATE)

III. DEMOGRAPHIC AND INSTITUTIONAL INFORMATION

To provide a context for analysis of information from sections I and II and for comparative analysis as part of the overall CSIP study, NSF needs some information about you, your department, your institution, and your undergraduate population.

18. Please provide the following information about yourself.

a. What is your highest degree? ______________________

b. In what year did you receive this degree? ______________________

c. How many years have you been on the faculty of your current institution? ______________________

		AT TIME OF PROPOSAL	CURRENTLY
d. What was/is your title?	Full Professor	☐	☐
	Associate Professor	☐	☐
	Assistant Professor	☐	☐
	Other (SPECIFY) ____________	☐	☐
e. What was/is your tenure status?	Tenured	☐	☐
	Untenured	☐	☐
	Not Tenure Track	☐	☐
f. What was/is your teaching load, (average number of teaching hours per week).		_______	_______

19. Please describe the faculty currently in the department where you have your primary appointment.

	NUMBER
a. Number of faculty members	____________
b. Number full-time	____________
1. Number with Ph.D. as highest degree	____________
2. Number with Masters as highest degree	____________
3. Number with Bachelors as highest degree	____________
c. Number part-time	____________

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20. Please describe the student enrollment in the department where you have your primary appointment.

		NUMBER
a.	Number of majors graduating per year (averaged over the last three years)	________
b.	Total departmental undergraduate opening fall enrollment in 1987	________

21. Use this space to write in any additional comments about CSIP or for continuations of answers to previous questions.

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How long did it take to fill out this form?

__________ Minutes

Please provide your name and phone number, in case additional information or clarification are needed.

Name: ______________________

Phone Number: ______/__________

CSIP - Site Visit Summary Report

Date of Visit ______________________________

Project Number ______________________________

School ______________________________

Principal Investigator ______________________________

Department Chairman ______________________________

Dean ______________________________

Westat Staff ______________________________

Consultant ______________________________

Use this form to summarize information obtained about each project by Westat staff and consultants during site visit interviews and other activities. Both members of the site visit team will meet after the site visit to discuss the questions and agree on responses.

1. Are there any updates/changes in project status as reported in the questionnaire?

- ☐ Same as in questionnaire
- ☐ Project is further along than presented in questionnaire
- ☐ Project is less far along than presented in questionnaire
- ☐ Not ascertained
- ☐ Not applicable

2. What kind of impact has the project had on:

	POSITIVE IMPACT	NO IMPACT	NEGATIVE IMPACT	NOT ASCERT.	NOT APPLIC.
a. Curriculum and instruction -					
new/modified courses	☐	☐	☐	☐	☐
new/upgraded topics	☐	☐	☐	☐	☐
teaching of subject	☐	☐	☐	☐	☐
b. Department faculty -					
morale	☐	☐	☐	☐	☐
interest in upgrading	☐	☐	☐	☐	☐
recruitment	☐	☐	☐	☐	☐
c. Principal Investigator -					
possibility for tenure	☐	☐	☐	☐	☐
salary	☐	☐	☐	☐	☐
work load	☐	☐	☐	☐	☐
other professional obligations	☐	☐	☐	☐	☐
d. Students -					
level of interest	☐	☐	☐	☐	☐
understanding of subject	☐	☐	☐	☐	☐
preparation	☐	☐	☐	☐	☐
e. Science instruction -					
usefulness as model	☐	☐	☐	☐	☐
f. Funding -					
acquiring matching funds	☐	☐	☐	☐	☐
leveraging additional money	☐	☐	☐	☐	☐
g. Department -					
prestige	☐	☐	☐	☐	☐
funding level	☐	☐	☐	☐	☐
space	☐	☐	☐	☐	☐
student enrollment	☐	☐	☐	☐	☐
student recruitment	☐	☐	☐	☐	☐
faculty recruitment	☐	☐	☐	☐	☐
instructional program	☐	☐	☐	☐	☐
h. Institution -					
grant administration process	☐	☐	☐	☐	☐
institutional support	☐	☐	☐	☐	☐
prestige	☐	☐	☐	☐	☐
student recruitment	☐	☐	☐	☐	☐

3. In what areas has the institution given support to the project:

		SOME SUPPORT GIVEN	NO SUPPORT GIVEN	PROBLEM AREA	NOT ASCERT.
a.	At the proposal stage -				
	initiation of proposal	☐	☐	☐	☐
	encouragement of submission	☐	☐	☐	☐
	preparation of proposal	☐	☐	☐	☐
b.	At the implementation stage -				
	release time	☐	☐	☐	☐
	additional space	☐	☐	☐	☐
	supplies	☐	☐	☐	☐
	technical support	☐	☐	☐	☐
	provisions for maintenance and repair	☐	☐	☐	☐

4. What is the climate for innovation and change in the department and the institution:

		YES	NO	NOT ASCERT.	NOT APPLIC.
a.	Innovation and change are seen as desirable -				
	in the department	☐	☐	☐	☐
	in the institution	☐	☐	☐	☐
b.	Program planning, development, and evaluation are done on a formal basis -				
	in the department	☐	☐	☐	☐
	in the institution	☐	☐	☐	☐
c.	The project was part of planned change -				
	in the department	☐	☐	☐	☐
	in the institution	☐	☐	☐	☐
d.	The P.I.'s efforts with respect to the project are recognized as valuable -				
	by the department	☐	☐	☐	☐
	by the institution	☐	☐	☐	☐
e.	Is the Department Chairman well acquainted with the project? (if too new check not applicable)	☐	☐	☐	☐
f.	Is the Dean well acquainted with the project? (if too new check not applicable)	☐	☐	☐	☐

5. Rate the success of this CSIP project in terms of:

		HIGH	MODERATE	NONE	NOT ASCERT.	NOT APPLIC.
a.	Achieving its original goals	☐	☐	☐	☐	☐
b.	Introducing modern instruments to improve the experiences of undergraduate students in laboratories and field work	☐	☐	☐	☐	☐
c.	Interfacing computers with scientific instrumentation for instruction purposes	☐	☐	☐	☐	☐
d.	Developing new ways of using instrumentation to extend instructional capabilities	☐	☐	☐	☐	☐
e.	Establishing equipment sharing capability via consortia or centers	☐	☐	☐	☐	☐
f.	Leveraging additional funds (beyond the required match)	☐	☐	☐	☐	☐

6. Have any of the following areas caused problems which held up project implementation or required the P.I. to expend more effort than anticipated to keep the project on schedule:

		MAJOR	MINOR	NONE	NOT ASCERT.	NOT APPLIC.
a.	Acquiring funds	☐	☐	☐	☐	☐
b.	Ordering, installing, and learning to use equipment	☐	☐	☐	☐	☐
c.	Operating and/or maintaining equipment	☐	☐	☐	☐	☐

7. What would have happened to this project in the absence of CSIP funds:

- ☐ Would have been mostly or fully implemented with institution funds
- ☐ Would have been mostly or fully implemented with outside funds
- ☐ Would have been mostly or fully implemented with a mix of funds
- ☐ A scaled-down version would have been implemented
- ☐ Would not have been implemented
- ☐ Not ascertained
- ☐ Not applicable

8. Did the questionnaire responses contain any significant omissions or exaggerations regarding:

		QUEX. UNDER STATES	QUEX. OVER-STATES	QUEX. ACCURATE	NOT ASCERT.	NOT APPLIC.
a.	Extent of progress in implementing project	☐	☐	☐	☐	☐
b.	Extent of changes from planned equipment	☐	☐	☐	☐	☐
c.	Extent of changes from planned objectives	☐	☐	☐	☐	☐
d.	Extent of resource leveraging	☐	☐	☐	☐	☐
e.	Extent of other project impacts	☐	☐	☐	☐	☐
f.	Type and extent of dissemination	☐	☐	☐	☐	☐

9. What role did each of the following play in the success of the project in achieving CSIP objectives?

		POSITIVE/BENEFICIAL HIGHLY 3	2	SLIGHTLY 1	BOTH/ NEITHER/ N.A. 0	NEGATIVE/ IMPEDIMENT -1
a.	P.I.'s initiative, effort, time-on-task	☐	☐	☐	☐	☐
b.	Other faculty	☐	☐	☐	☐	☐
c.	Department administrators	☐	☐	☐	☐	☐
d.	Institution administrators	☐	☐	☐	☐	☐
e.	Student Assistants	☐	☐	☐	☐	☐
f.	Others (specify) ______________	☐	☐	☐	☐	☐

10. Report briefly on questionnaire feedback from the respondent.

____

____

____

____

____

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11. Report briefly on other recommendation from P.I. concerning CSIP, NSF, and dissemination.

12. How well is this project doing, and why?

NATIONAL SCIENCE FOUNDATION
WASHINGTON, D.C. 20550

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NSF 91-27