

# SRI International

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## **EVALUATION OF THE RESEARCH EXPERIENCES FOR TEACHERS (RET) PROGRAM**

### **Final Report**

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#### Disclaimer

Any opinions, conclusions, or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the United States Government.

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## **ACKNOWLEDGMENTS**

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# EXECUTIVE SUMMARY

## INTRODUCTION

In FY 2001, the National Science Foundation's (NSF's) Directorate for Engineering (ENG) initiated the Research Experiences for Teachers (RET) Program. The Program, inspired by the popularity of the Research Experiences for Undergraduates (REU) funding mechanisms, is intended to bring knowledge of engineering and technological innovation to the pre-college classroom. The goal is to help build long-term collaborative partnerships between K-14 science, technology, engineering, and mathematics (STEM) teachers<sup>1</sup> and the NSF research community by involving the teachers in ENG-funded research and then helping them translate their research experiences into classroom activities. Partnerships with inner city schools and schools in other less well-funded districts are especially encouraged, as is participation by underrepresented minorities, women, and persons with disabilities. It is intended that the research activities occur over a period of at least 4 weeks during the summer, with "sustained follow-up" over the course of the subsequent academic year.

There are two mechanisms of RET support: RET Supplements and RET Sites. RET Supplements may be included in proposals for new or renewal ENG grants or as supplements to ongoing ENG-funded projects. RET Sites are based on independent proposals to initiate and conduct research participation projects for a number of K-12 teachers and/or community college faculty.

In 2003, NSF contracted with SRI International (SRI) to evaluate the ENG RET Program. The primary objective was to better understand how the RET experiences of the 2001-2003 ENG RET participants affected their teaching techniques, attitudes about teaching, and professional development activities. Outcomes and impacts beyond the teachers' own classrooms, such as knowledge transfer activities, formal partnerships formed between the RET Principal Investigator (PI) and the teacher's school system/district also were examined. The study did not assess the impacts of RET on students, other than through participants' reports of Program impacts on their students.

Data collection for the study was conducted during the summer and fall of 2004 through an online survey. The survey population included all 2002 and 2003 participants in ENG RET Site awards and all 2001 to 2003 participants in ENG RET Supplement awards made by the Engineering Research Centers (ERC) Program, the Division of Bioengineering and Environmental Systems (BES), and the Division of Design, Manufacture, and Industrial Innovation (DMII). Note that, although the study included only those ENG groups noted above, for simplicity we will refer to the survey population/respondents as "2001-2003 ENG RET Participants." RET PIs—the ENG-funded researchers in whose research the teachers participated—were contacted to obtain names and e-mail addresses of participants. The PIs provided information for a total of 506 individuals, of whom 409 were determined to be eligible for the survey. (Most of the ineligible said they had never heard of RET or had not participated in it.) Completed questionnaires were obtained from 301 participants.

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<sup>1</sup> The program encourages the participation of both in-service and pre-service (education majors who are still pursuing their degrees) teachers. In FY 2001 and 2002, the program included only K-12 teachers; in FY2003, community college faculty were added to the target audience.

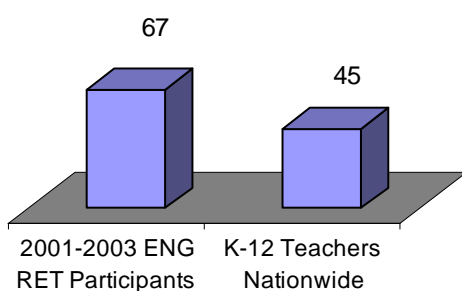
## KEY SURVEY FINDINGS

### 2001-2003 ENG RET Participants Were Diverse

ENG RET participants were a diverse group demographically, as well as in terms of the schools in which they taught, the kinds of students they taught, and the STEM subjects they taught. Proxy questions for student income level<sup>2</sup> suggested that, consistent with NSF's interest, low-income schools were indeed represented by RET participants, but there were at least as many teachers who appeared to be from relatively affluent schools.

### Participants Tended to Be Well-Qualified Teachers

Percentages of 2001-2003 ENG RET Participants and K-12 Teachers Nationwide Who Have a Master's Degree

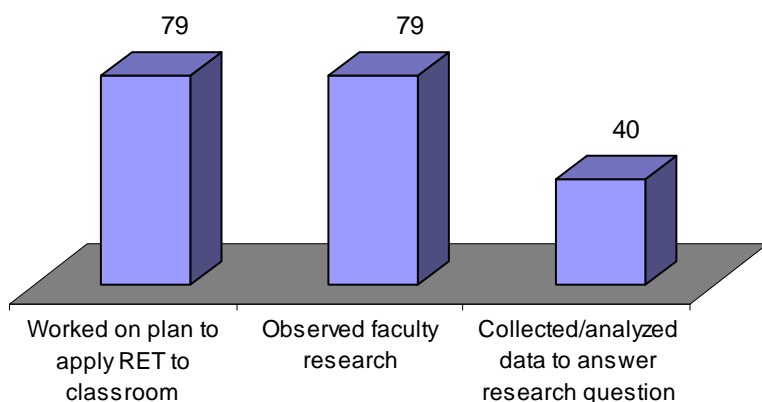


All but 2% of 2001-2003 ENG RET participants were teachers immediately before participating in RET, and 92% were teachers at the time of the survey. Participants were considerably more likely than K-12 teachers nationwide to have obtained an advanced degree. To the extent that an advanced degree can be considered an indicator of higher-quality teaching, this finding suggests that, like many teacher enrichment programs, RET has tended to attract the better-qualified teachers.

Sources: SRI International RET survey, 2004; 1999-2000 Schools and Staffing Survey, National Center for Education Statistics.

### Hands-on Research Was Not a Major Focus of Most RET Experiences

Percentage of 2001-2003 ENG RET Participants Who Did Each Activity



Relative to the typical undergraduate research experience, the RET experience focused much more on watching, listening, and developing classroom plans than on hands-on research. For example, about 8 in 10 worked on classroom plans and observed faculty research activities, but only 4 in 10 collected or analyzed data to try to answer a research question. By comparison, 86% of undergraduates in 2003 REU projects collected or analyzed data.<sup>3</sup>

Source: SRI International RET survey, 2004.

<sup>2</sup> Estimated percentage of students eligible for a free or reduced-price lunch and estimated percentage of students who have access to the Internet at home.

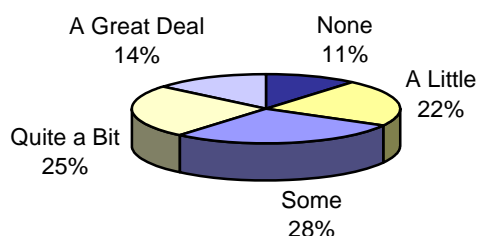
<sup>3</sup> Russell, S.H. (2005) Evaluation of NSF support for undergraduate research opportunities: survey of NSF-program participants (Report to the National Science Foundation). Menlo Park, CA: SRI International.

## Most Summer Projects Were Full-Time, 6-Week Experiences

RET Program guidelines state that RET summer projects should be at least 4 weeks long. The survey found that this guideline was met or exceeded by a large majority of RET projects: 84% of participants said their summer project lasted at least 4 weeks, and the average was almost 6 weeks. Similarly, most reported that while the project lasted, it was essentially a full-time experience.

## The Amount of Follow-up Interaction Varied

**Amount of RET Follow-up Interaction Reported by 2003 ENG RET Participants**



Source: SRI International RET survey, 2004.

RET Program announcements for FY 2002 and FY 2003 indicate that follow-up is a central element of the Program, and a number of respondents commented on the importance of follow-up. For instance, one said, “[The most important impact of RET] has been the graduate students coming into the classroom and doing hands-on demonstrations.” However, the amount of follow-up varied substantially, and twice as many 2003 participants reported no or only a little follow-up as reported a great deal of follow-up (33% vs. 14%, respectively).

## Satisfaction Levels Were High for the Experience Overall but Lower for Some Key Aspects

Most participants were enthusiastic about their RET experiences overall: between about 70% and 75% were “very satisfied” with their experience as a whole and felt that the amount of time spent on hands-on research and curriculum development was “about right.” Said one participant, “RET has been the most useful experience that I have ever had in education.” On the other hand, only about half were very satisfied with their mentor’s knowledge of the roles/responsibilities of K-12 STEM teachers or with their mentor’s interest in helping them develop classroom plans.

Important correlates of overall satisfaction included the experience’s relevance to the classroom, having participated in a variety of project activities, and having done at least something that seemed like “real research.”

## The Vast Majority of Participants Reported Diverse Positive Project Outcomes and Impacts

Twenty-seven of 42 listed potential positive project outcomes were reported by more than half of the respondents, and 12 were reported by more than three-fourths, indicating that the Program overall had a wide variety of positive short-term effects. Below are outcomes reported by 80% or more of respondents.

Increased my general knowledge base in STEM	98%
Increased my motivation to find ways to improve my students’ learning	94
Increased my ability to convey the excitement/vitality of STEM to students	89
Increased my awareness of current STEM research issues	88
Increased my confidence in my ability as a STEM teacher generally	87

Increased my professional opportunities	81
Assign more projects based on “real world” problems	81
Included examples or applications from my RET activities in my teaching	81
Tell students more about or use more new technologies	80

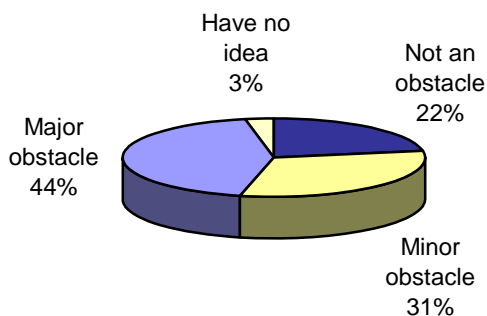
Over 80% of respondents also reported positive effects on their students. Most common were students’ increased awareness of STEM career options (56%), more positive attitudes about STEM subjects in general (53%), and greater interest in the respondents’ classes (52%).

### Collaborative Relationships Are Less Common Than Positive Outcomes for Individuals

The Program’s goal is to help build long-term collaborative relationships between K-14 teachers of science and mathematics and the NSF research community. About half of the respondents reported either that such a relationship already existed (23%), that one was developed as a result of their RET participation (11%), or that one was likely to be developed in the future (20%). The survey also found that all but 16% of respondents participated in RET for just one summer in 2001 through 2003, and, as noted above, twice as many respondents reported no or only a little follow-up as reported a great deal of follow-up. Taken together, these results suggest that there probably is not as much relationship-building occurring as NSF intended.

### High Cost of Materials and Equipment is the Biggest Obstacle to Transferring RET Knowledge to the Classroom

**Expense of Materials and Equipment as an Obstacle to Transferring RET Knowledge to the Classroom, 2001-2003 ENG RET Participants**



Source: SRI International RET survey, 2004.

By a considerable margin, the high cost of materials and equipment was overall the biggest obstacle, rated as a major obstacle by 43% of respondents and as a minor obstacle by another 31%. The next biggest obstacle overall was not having enough time to prepare new lesson plans, rated as a major obstacle by 24% and a minor obstacle by 41%.

### Relevance to Subjects Taught, Academic-Year Follow-up, Involvement in a Variety of Activities, and Multi-Summer Participation Were Key to Desired Project Outcomes

Among participants who currently teach, about 6 in 10 reported that, overall, the RET activities were “very relevant” to the subjects they currently teach, a third said RET activities were “somewhat relevant,” and 4% said they were “not at all relevant.”

Participants for whom the RET experience was very relevant to subjects they taught in the classroom were considerably more likely than those for whom the experience was somewhat or

not relevant to have reported diverse positive outcomes and effects on their students. Positive outcomes also were strongly related to the amount of follow-up interaction experienced, overall satisfaction with the experience, and the variety of project activities undertaken. Participants who were involved with the project for more than one summer also reported more diverse and powerful outcomes than did those who were involved for a single summer. There were few appreciable relationships between school or participant characteristics and project outcomes.

### **Participants Gave Wide Variety of Suggestions for Program/Project Improvement**

Participants' suggestions covered such issues as project organization, consultation with the teachers themselves, mentor support, project follow-up, and expanded participation opportunities. For example:

*RET participants need to know at least 2 to 3 months in advance what they will be researching. This will provide time to gain background information.*

*The orientation session should include a syllabus of some sort, scheduling out activities for specific days and setting clear goals.*

*Please consult high school teachers when planning these summer programs. Ask high school teachers what they need to help them in the classroom.*

*Don't put a RET participant who teaches biology into a technology laboratory.*

*Let us participate more in the lab. The PIs seriously underestimate the abilities and intellectual capabilities of some teachers.*

*I would like to see more of a commitment from the university or program for implementation of curriculum into my schools.*

*More teachers need to do it! More publicity! More colleges and universities buying into the program!*

### **OVERVIEW AND RECOMMENDATIONS**

A large majority of 2001-2003 ENG RET participants were enthusiastic about their participation in the Program. Almost all reported that they had received a variety of personal and professional benefits from the Program, including new enthusiasm for their STEM teaching; new teaching strategies; a greater awareness of STEM research methods, issues, and career opportunities; and enhanced professional opportunities. Moreover, the vast majority said that their students also had benefited, most often through increased enthusiasm for STEM subjects and increased awareness of STEM careers.

Even highly effective programs, however, can be even more effective. Below is a summary of SRI's major suggestions for achieving this end.

- If the Program goal is truly to help develop long-term relationships, consider ways of promoting this goal explicitly.
- Increase participant awareness and understanding of the Program by preparing and requiring PIs to distribute a brochure outlining the Program goals and requirements.
- Encourage PIs to focus on making the summer experience relevant to participants' K-14 classroom needs.
- Encourage PIs to include a variety of activities in the summer projects, one of which must be hands-on research.

- Look for ways to ensure that academic-year follow-up activities take place.
- Work to ensure that adequate funds are available for materials and equipment needed to translate RET experiences for classroom instruction and learning.

## Highlights of Participant Feedback

*I think the single most important outcome of participation in RET was a better knowledge of how science is used in the real world, and how the STEM skills can be applied to problem solving in all areas of life.*

*From this experience I have copublished twice, regularly collaborated with area colleges, improved my courses, and instructed fellow K-12 teachers in the design process in our state curriculum frameworks.*

*It made me more aware of some of the new STEM challenges on the horizon and more capable of exciting my students about STEM careers.*

*I feel very confident in my ability to think and act like a scientist, and it's given me more confidence as an upper level chemistry teacher.*

*The biggest impact was when my students started telling students on the other teams about their “cool” activities. The other teachers then came to me to learn about the activities, including how to use the equipment. I wound up teaching the activities to the other teams while they covered my classes. So instead of just reaching my students, I was able to connect with the entire eighth grade, approximately 400 students.*

*It gave me background experience to become the science coordinator, which the school had never had before.*

*The partnership with the [RET university] has helped me create a summer camp to encourage middle school students to seek engineering careers.*

*Because we had a graduate student we were able to bring in neat labs and run an after school program. This opened the eyes of students so they could see and hear about someone doing real research. Also my students took a tour of the university and the program I was involved in. This was a great opportunity for them to be exposed to STEM in the real world.*

# I. INTRODUCTION

## BACKGROUND

### Initiation of the Research Experiences for Teachers (RET) Program

The RET Program was initiated in FY 2001 by the Directorate for Engineering (ENG) of the National Science Foundation (NSF), inspired by the popularity of the Research Experiences for Undergraduates (REU) Site and Supplement funding mechanisms. The October 2000 “Dear Colleague” letter inviting RET Supplement proposals from researchers with active ENG research awards stated:

The goal of the RET Supplements is to help build long term collaborative relationships between K-12 teachers of science and mathematics and the NSF research community. The Directorate for Engineering at NSF is particularly interested in encouraging its researchers to build mutually rewarding partnerships with teachers at inner city schools and less well-endowed school districts.

Proposers were instructed to describe the nature of the prospective teacher’s involvement in the research and the follow-up that would be provided to help ensure that the teacher’s research experiences would be translated into classroom activities. Supplements were 1-year awards covering up to two teachers’ stipends, plus up to \$1,000 for materials for developing classroom instructions and experiments, up to a total of \$10,000 per teacher. RET activities could occur during the summer, the academic year, or both.<sup>1</sup> In January 2001, the Engineering Research Centers (ERC) Program within ENG also announced RET supplemental funding opportunities for the ERCs, as one of a number of eligible education activities. Within ERCs, RET funds of up to \$50,000 per year for up to 3 years were available.

### Changes to RET in FY 2002

In FY 2002, the ENG RET activity was expanded to include stand-alone RET Site awards, analogous to (and often operated in conjunction with) REU Site awards. RET sites are required to “have a well-defined focus, with clearly articulated projects and activities for participating teachers;” they should normally be at least 4 weeks long; and they should involve at least five teachers. As with RET supplements, the sites are required to provide “sustained follow-up” to help translate research activities to the classroom. Also, for both sites and supplements, participation of teachers who are women, underrepresented minorities, and persons with disabilities is strongly encouraged. Per-teacher funding levels for sites are the same as those for supplements, but sites may be awarded up to \$150,000 per year for up to 3 years.

Several additional changes were made in the FY 2002 ENG RET “Dear Colleague” letter including:

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<sup>1</sup> Then and now, RET research—in both supplements and sites—occurs during the summer, with follow-up during the academic year. Thus, RET supplements tend to differ from REU supplements in that the bulk of RET activities usually occur during an intensive summer program, whereas REU supplement activities are more likely to be spread out over the academic year, while the student is attending classes.

- Preservice teachers were added to the target audience.
- Partnerships with schools supported through the NSF Urban Systemic Program (USP) were specifically encouraged (with additional funds for such partnerships available through the USP).
- The goal of encouraging “more K-12 students to pursue engineering studies by increasing their understanding of engineering, as conveyed by their teachers” was articulated.

Also in FY 2002, two other NSF directorates—Biological Sciences (BIO) and Computer and Information Science and Engineering (CISE)—also offered RET Supplement awards analogous to those offered by ENG, and the Mathematical and Physical Sciences (MPS) directorate offered both Supplement and Site awards.

### **RET in FY 2003**

In FY 2003, the ENG RET Program was again expanded, this time to include community college faculty. Other Program requirements for sites and supplements were unchanged from FY 2002. As described in the FY 2003 RET Program solicitation, it was intended that the teacher-researcher partnerships built through RET experiences will:

- Build long-term collaborative relationships between both inservice and preservice K-12 teachers, community college faculty, and the engineering research community.
- Support the active participation of these teachers and future teachers in research and education projects funded by NSF ENG.
- Facilitate professional development of K-12 teachers and community college faculty through strengthened partnerships between institutions of higher education and local school districts.
- Encourage researchers to build mutually rewarding partnerships with teachers.

### **STUDY OBJECTIVE**

The primary objective of the study was to better understand how ENG RET experiences affected participants’ teaching techniques, attitudes about teaching, and professional development activities. Outcomes and impacts beyond the teachers’ own classrooms, such as knowledge transfer activities and formal partnerships formed between the institution of the RET Principal Investigator (PI) and the teacher's school system/district, also were examined. The study did not assess the impacts of RET on students, other than through participants’ reports of project impacts on their students.

### **SURVEY METHODS**

#### **Obtaining Participant Contact Information**

The survey population included all 2002 and 2003 participants in ENG RET Site awards and all 2001 to 2003 participants in ENG RET Supplement awards made by the Engineering Research Centers (ERC) Program, the Division of Bioengineering and Environmental Systems (BES), and the Division of Design, Manufacture, and Industrial Innovation (DMII). In August/September 2003, NSF program officers in the three ENG divisions participating in the

study initiated the efforts to obtain participant contact information by e-mailing their RET-award PIs, requesting names and contact information for all participating teachers. Program officers sent several follow-up e-mails over the next several months to remind PIs to supply the needed information.

In December 2003, NSF turned the contact information files over to SRI staff. The files included names of a total of 127 PIs. At this point, no information had been obtained from 74 PIs (58%), whom SRI began contacting by telephone. Ultimately, 512 RET participants (each with an e-mail or postal address) were identified by a total of 102 PIs. Six of the 512 participated in the pretest, leaving 506 in the survey sample.

## **Questionnaire Development**

To help guide development of the questionnaire, SRI consulted with the NSF program officer who was managing the study and the ENG RET coordinator, reviewed earlier studies of RET projects conducted by PIs, and interviewed study authors and others knowledgeable about the Program. We also were guided by our experience surveying REU participants. In addition, the questionnaire was pretested with six RET participants to help ensure that the questions were clear and easily understandable and that most respondents would be willing and able to provide the information requested. Pretests were conducted by faxing the questionnaire to individuals who had agreed to help and then having each individual answer the questionnaire in a telephone interview with an SRI researcher. During each pretest session, the SRI researcher probed for areas of potential difficulty or ambiguity. Modifications made as a result of pretests were then pretested with other individuals to confirm that the changes were indeed improvements.

After the questionnaire was finalized, it was formatted in HTML for a Web-based data collection effort. The Web version was tested to be sure that skip logic was correct and that responses were retrieved and reported correctly by the survey software. The Word version of the questionnaire comprises Appendix A to this report. Survey topics are outlined below.

### **Independent variables**

Teacher characteristics:

- School location (geographic region; urban, suburban, rural)
- Teaching or school level
- Educational background
- Number of years as a teacher
- Subjects taught
- Types of students (e.g., advanced, remedial, ESL, LD)

RET project activities and characteristics:

- Year(s) of participation
- Project duration
- Pre-project contacts with mentor
- Post-project follow-up
- Teachers' activities during RET
- Relevance to subjects taught
- Type(s) of organization at which project took place

NSF characteristics:

- RET mechanism (site vs. supplement)
- Directorate and division of RET award

### **Outcome variables**

Teachers' reports of RET experiences

- Level of satisfaction/dissatisfaction with different aspects of the project/Program
- Impact of the project on various dimensions (e.g., understanding of fundamental STEM concepts, awareness of STEM career options, confidence as a STEM teacher, enthusiasm for teaching)

Teaching-related changes, such as:

- Revision or development of new content for lessons/labs
- Inclusion of examples/applications from RET experiences in teaching
- Counseling students about STEM careers
- Greater use of instructional strategies derived from RET experience

Other professional outcomes:

- Enrollment in STEM or STEM education courses or programs
- Increased involvement in other STEM-related activities
- Career changes
- Turnkey and institution-level effects, such as:
  - Workshops for other teachers
  - Sharing of RET-derived equipment/materials with other teachers
  - Partnerships between RET teachers' schools/districts and colleges/universities
  - Continuing contact with RET mentors/researchers or other RET teachers

### **Impact variables**

Teachers' reports of changes in students:

- Attitudes about STEM subjects
- Learning of STEM subjects
- Changes in career aspirations

### **Obstacles to transferring RET experiences to the classroom**

- Level of knowledge needed for RET too high for teachers' students
- Scientific topics covered in RET unrelated to subjects taught
- Not enough time
- Cost of materials and equipment
- School curriculum that does not allow for changes
- Administrative resistance or lack of support
- Resentment or lack of support from other teachers

## Data Collection

**Questionnaire administration.** For sample members who had e-mail addresses (n = 471), the first step in administering the questionnaire was to e-mail them a survey notification, directing them to a Web site to complete the questionnaire. Seven follow-up reminders were e-mailed over a 14-week period to those who had not yet responded (weekly for 2 weeks and then approximately every 2 weeks for 3 months). Questionnaires were sent by postal mail to 82 individuals, 35 of whom did not have an e-mail address and 47 whose e-mail address was invalid. A reminder postcard was mailed a week later, followed by a second copy of the questionnaire in two weeks and a third copy a month later. SRI made a final attempt to contact by phone 174 individuals who had not yet responded, to encourage their response.

The e-mail notification and postal cover letter included a brief study overview describing study objectives, funding, privacy and burden, how the participants were selected, and how to obtain a copy of the study results or more information about the study. A survey ID number was embedded in the URL and placed on the front of the mailed questionnaire so that SRI could identify those who had responded and remove them from the follow-up list.

The disposition of the survey sample is presented below.

a. Completed questionnaire	301	.
b. Refused	22	
c. Incomplete questionnaire	3	
<b>d. Total eligible</b>	<b>326</b>	
e. Not RET participants	64	
f. Participated only in 2004	12	
g. Duplicate	1	
<b>h. Total ineligible</b>	<b>77</b>	
i. Bad address	37	
j. No response	66	
<b>k. Total unknown eligibility</b>	<b>103</b>	
<b>l. Total sample</b>	<b>506</b>	

The survey response rate was calculated as the percentage of those known or estimated to be eligible who completed the questionnaire, as follows:

1. Estimate the eligibility rate of those with unknown eligibility.

$$d/(d + h) = 326/(326 + 77) = 0.809$$

2. Multiply the estimated eligibility rate by the number of cases with unknown eligibility.

$$0.809 * k = 0.809 * 103 = 83.3$$

3. Add the number estimated to be eligible to the number known to be eligible.

$$83.3 + d = 83.6 + 326 = 409.3$$

4. Divide the number who completed the questionnaire by the total known + estimated eligible.

$$a/(409.3) = 301/409.3 = .735 = 74\%$$

Table I-1 shows the numbers of individuals identified by RET PIs as participants and the number who responded, by RET type (site vs. supplement) and ENG division.

<b>Table I-1</b>		
<b>Survey Sample and Respondents, by RET Type and ENG Division*</b>		
<b>RET Type</b>	<b>Participants Identified by RET PIs</b>	<b>Survey Respondents</b>
ERC RET supplements	361	198
BES and DMII RET supplements	45	33
ENG RET sites	100	69
Unknown	--	1
<b>TOTAL</b>	<b>506</b>	<b>301</b>
*The three ENG divisions participating in the study were BES, DMII, and EEC. Source: SRI International RET survey, 2004.		

## Data Cleaning and Analyses

Data analyses focused largely on describing and explaining the outcomes and impacts of the projects/Program. Descriptive tabulations were used to show the percentages of participants, overall and by subgroups, who experienced the various outcomes. In the explanatory analyses, we used factor analyses to develop indices of outcomes and impacts. We then used crosstabulations and *t*-tests to compare mean “outcomes scores” across subgroups of respondents.

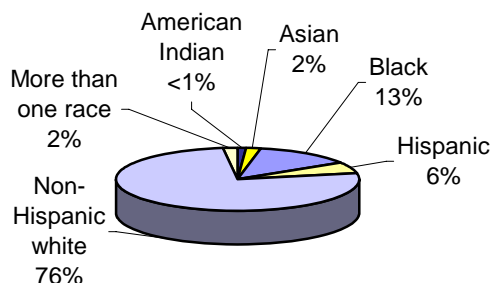
Subgroup comparisons noted in this report are statistically significant at the .05 level. This means, essentially, that the odds are less than 5 in 100 that the “significant” difference occurred only by chance. Because statistical significance does not necessarily connote practical importance, we use statistical significance as a necessary but not sufficient cause for remark; typically, unless a percentage difference is greater than 10 percentage points *and* is statistically significant, we do not consider it to be noteworthy.

## II. PROFILE OF 2001-2003 ENG RET PARTICIPANTS

As noted previously, the survey population included all 2002 and 2003 participants in ENG RET Site awards and all 2001 to 2003 participants in ENG RET Supplement awards made by ERC, BES, and DMII. For simplicity we will refer to the survey population/respondents as “2001-2003 ENG RET Participants.” This chapter provides a broad description of the demographic and academic characteristics of the 2001-2003 ENG RET participants. The survey data presented here are based on information provide by a total of 301 respondents.

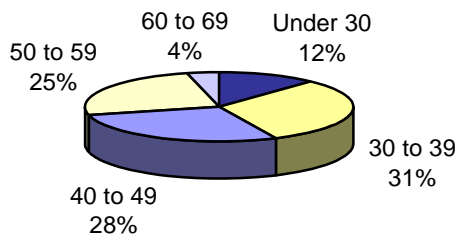
### DEMOGRAPHIC CHARACTERISTICS

**Figure II-1**  
Distribution of 2001-2003 ENG RET Participants, by Race/Ethnicity



Source: SRI International RET survey, 2004.

**Figure II-2**  
Distribution of 2001-2003 ENG RET Participants, by Age



Source: SRI International RET survey, 2004.

Figure II-1 shows the distribution of 2001-2003 ENG RET participants by race/ethnicity. About 8 in 10 were non-Hispanic whites. Among the minority groups, blacks had the highest representation, with 13%. As a very approximate comparison, 84% of K-12 teachers nationwide were non-Hispanic whites, 7% were black, and 5% were Hispanic.<sup>2</sup> Participants were approximately evenly divided between men (54%) and women (46%). It would appear from these data that the Program is doing a reasonably good job of recruiting groups that are traditionally underrepresented in STEM fields. ENG RET participants also were well distributed across age decades, with 43% under age 40 and 57% age 40 or older (Figure II-2).

Almost all ENG RET participants (98%) were teachers immediately before participating in the Program, and 92% were teachers at the time of the survey. Of the 6% (n = 20) who were teachers before RET but not at the time of the survey, 7 had become school administrators, 2 had become curriculum specialists, 3 had gone back to school, 4 had retired, and 4 had made some other change.

### ACADEMIC CHARACTERISTICS

As is often true of enrichment program participants, the ENG RET participants tended to be better educated than the average K-12 teacher: 67% had at least a master's degree and 5% had a doctorate; the comparable percentages for K-12

<sup>2</sup> Percentages were calculated using statistics provided by the 1999-2000 Schools and Staffing Survey (SASS), National Center for Education Statistics, available at <http://nces.ed.gov/surveys/SASS/>. Note that to make direct comparisons between ENG RET participants and the population of all U.S. K-12 teachers one would need to weight on a variety of dimensions, including subjects taught, school level, and so on. Such an effort would involve time and resources beyond the scope of this study.

teachers nationwide were 45% and less than 1% (1999-2000 SASS). Also, ENG RET participants averaged about 13 years of teaching experience, 3 years less than the 16-year average reported by SASS for K-12 teachers nationwide.

The academic fields in which participants obtained their degrees are summarized in Table II-1. As undergraduates, 77% of ENG RET participants majored in a STEM field, and

**Table II-1**  
**Academic Fields of 2001-2003 ENG RET Participants' Bachelor's, Master's, and Doctoral Degrees**

	<b>Bachelor's (n = 282)</b>	<b>Master's (n = 193)</b>	<b>Doctorate (n = 20)</b>
<b>STEM</b>			
Chemistry	7%	2%	15%
Engineering/technology	10	9	20
Life sciences	24	7	10
Mathematics	10	2	0
Physical/earth sciences	12	6	20
Social sciences	11	3	5
Science (general)	3	1	0
<b>Education</b>			
Technology education	15	20	5
Education (general)	15	52	25
Other	12	6	0

This table shows, for example, that 7% of ENG RET participants who received a bachelor's degree majored in chemistry.

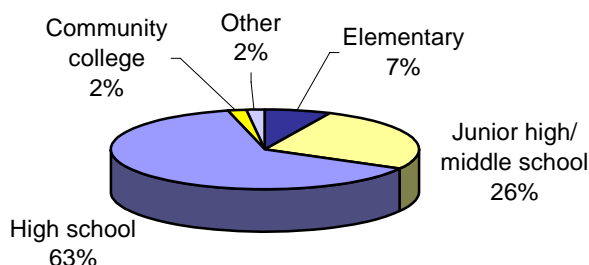
Source: SRI International RET survey, 2004.

another 15% majored in STEM education; 15% majored in (general) education, and 12% majored in some other field. Participants' master's degrees were much less likely to be in a disciplinary field. Of those who obtained a master's degree, 30% obtained their degree in a STEM field, 20% in STEM education, 52% in (general) education, and 6% in some other field. Among the few doctorates, 70% were in disciplinary areas.

Participants with degrees in STEM disciplines were most likely to teach at the high school level (69% did so), whereas those with non-STEM degrees were equally likely to teach high school (49%) as middle or elementary school (50%). STEM degree holders also were more likely than non-STEM degree holders to teach biology and physics. (For example, 34% of STEM degree holders taught biology, compared with 19% of non-STEM degree holders.)

## SCHOOL CHARACTERISTICS

**Figure II-3**  
**Distribution of 2001-2003 ENG RET Teachers, by Level of School in Which They Taught**



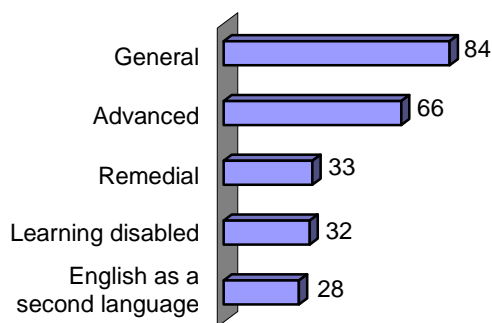
Source: SRI International RET survey, 2004.

As noted above, 92% of the respondents indicated that at the time of the survey they were teachers. Sixty-three percent of the teachers taught in high schools, 26% were in junior high or middle schools (Figure II-3).

Among those in K-12 schools, the vast majority (80%) taught in public district schools; 14% taught in public magnet schools, 5% taught in private schools, and 1% taught in other kinds of schools. About half (48%) of the schools were urban, 35% were suburban, and 17% were rural.

As a group, ENG RET teachers taught a diverse array of STEM topics, of which physics (taught by 34% of participants), biology (30%), math (27%), chemistry (25%), and technology education (18%) were the most common. They also taught diverse types of students (Figure II-4).

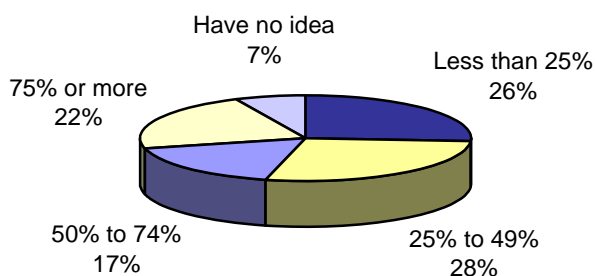
**Figure II-4**  
**Percentages of 2001-2003 ENG RET Teachers Who Taught Each Listed Type of Student**



Source: SRI International RET survey, 2004.

NSF encourages RET PIs to develop partnerships with teachers in inner-city schools and less well-funded school districts. As a proxy, we asked respondents to indicate the approximate percentage of students at their school who were eligible for a free or reduced-price lunch (fewer than 25%, 25% to 49%, 50% to 74%, 75% or more, or have no idea). Among those who gave an estimate, 42% reported that at least half of the students were eligible for a subsidized lunch. (Figure II-5).

**Figure II-5**  
**Distribution of 2001-2003 ENG RET Participants, by Percentage of Their School's Student Body That is Eligible for Free/Reduced Price Lunch**



Source: SRI International RET survey, 2004.

Another indication of student affluence is the percentage who have access to the Internet at home. Given the same response categories as were used for the school lunch question, 66% of those who gave an estimate said at least half had home Internet access; only 15% said fewer than 25% had home Internet access. The sizeable number of students in the “subsidized lunch” group indicates that low-income schools were indeed represented by RET participants; however, the sizeable number in the “home Internet access” group indicates that more affluent schools also are well represented.

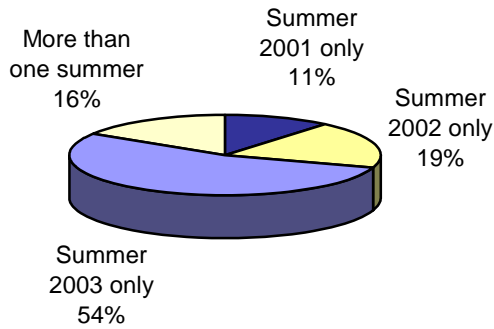
## **SUMMARY OF PROGRAM PARTICIPANTS' CHARACTERISTICS**

ENG RET participants in 2001 through 2003 were a diverse group demographically as well as in terms of the kinds of students they taught, the schools in which they taught, and the STEM subjects they taught. One notable difference between participants and the average K-12 teacher was that participants were considerably more likely to have obtained an advanced degree. Low-income schools appear to be represented but do not predominate.

### III. PARTICIPANTS' RET EXPERIENCES

#### SUMMERS OF PROJECT PARTICIPATION

**Figure III-1**  
**Distribution of 2001-2003 ENG RET Participants,**  
**by Summer of RET Participation**



Source: SRI International RET survey, 2004.

Two thirds (66%) of the survey respondents reported that they participated in the Program during summer 2003, 34% participated during summer 2002, and 21% participated during summer 2001. At least to some extent, this distribution reflects the fact that PIs were more likely to have names and contact information for recent participants than for those who participated further in the past.

The vast majority of participants (84%) participated in the Program for only one summer (Figure III-1). Of those who participated during two or more summers, half (51%) spent two or more summers in the same RET project.

#### LOCATION OF PROJECT PARTICIPATION

For almost nine in ten of participants (87%), the summer RET experience took place at a 4-year college or university (Table III-1).

**Table III-1**  
**Locations of 2001-2003 ENG RET Summer Projects**

	<i>n</i>	2-Year College	4-Year College or University	Hospital or Medical Research Facility	Non-Profit Research Organization	U.S. Government Lab	For-Profit Company*	Other**
Summer, 2001	62	0%	90%	13%	3%	5%	2%	5%
Summer, 2002	100	1	84	10	1	6	6	1
Summer, 2003	195	2	83	4	1	3	12	2
OVERALL	295	1	87	7	2	4	9	3

This table shows, for example, that 0% of Summer 2001 ENG RET participants reported that their activities took place at a 2-year college.

Note: Percentages for each summer sum to more than 100 because respondents were allowed to select more than one type of institution.

\*E.g., Small Business Innovation Research (SBIR) Program recipients.

\*\*E.g., K-12 school, municipal facility, community resource group.

Source: SRI International RET survey, 2004.

By far the most common mode of attendance in the summer projects was to commute. In 2001 and 2002, about eight in ten participants commuted, and in 2003 about nine in ten did so. Most other participants were housed on or near the host institution's campus, but a few commuted during some of the project and were housed on campus for other parts.

## PREPARATIONS FOR PARTICIPATION IN RET

The most common kinds of pre-project contact by participants were phone calls or e-mails with the RET mentor, PI, or project coordinator, reported by 89% of respondents. Two-thirds (67%) of respondents said they received materials describing the RET work they would be doing, and 61% met in person with a project representative to discuss their upcoming summer activities. Eight in ten respondents (82%) reported that they attended some kind of in-person individual or group orientation session at the start of the summer project.

About 6 in 10 respondents reported that, when they started work during their first RET summer, they were "very well informed" about project logistics such as locations of activities, parking, meals, administrative issues, and so on (Table III-2). Approximately half were very well informed about the summer's scheduled activities, the summer project's objectives, what the participants were expected to accomplish, and the overall RET Program objectives. Participants who were involved in three or four of the preparatory activities (noted in the preceding paragraph) were more likely than those who were involved in fewer than three to have said they were very well informed. Nevertheless, only 35% of those who were involved in all four preparatory activities reported that they were very well informed on all dimensions shown in Table III-2.

	<i>n</i>	Mean Rating	Not At All Informed	Somewhat Informed	Pretty Well Informed	Very Well Informed	Don't Remember
Project logistics (locations of activities, parking, meals, administrative issues, etc.)	299	3.50	2%	9%	25%	63%	1%
The scheduled activities for the summer	298	3.38	3	12	28	56	1
The objectives/goals of your RET summer project	299	3.25	4	15	32	48	<1
What you were expected to do/accomplish during the summer	299	3.22	3	16	34	45	1
The overall RET Program objectives/goals	300	3.20	3	20	31	45	1

This table shows, for example, that 2% of the participants reported that they were not at all informed about project logistics when they started work during their first RET summer.  
 Note: Mean ratings are based on a 4-point scale in which 1 = not at all informed, 2 = somewhat informed, 3 = pretty well informed, and 4 = very well informed.  
 Source: SRI International RET survey, 2004.

## SUGGESTIONS FOR IMPROVING PREPARATORY MEETINGS AND INFORMATION

Asked how they thought the preparatory information, meetings, or orientation session could be improved, 34% of the respondents provided suggestions or comments about difficulties. The most common suggestion was for more information about project activities and objectives and participant responsibilities. For example:

*The orientation session should include a syllabus of some sort, scheduling out activities for specific days and setting clear goals.*

*Very little was clearly defined for those of us in the program. I was given conflicting information about the goals of the program, my responsibilities, what I was supposed to accomplish.*

*The PIs should be present at the orientation and give small overviews of their projects including goals and objectives.*

*What content is to be taught needs to be discussed at an orientation meeting. An orientation meeting would have saved some anxious moments and headaches for participants and those teaching the course.*

A number of respondents suggested that having more information in advance would have been useful.

*I never received any written information concerning the goals of the project and requirements of RET. I was only orally briefed. A mailed package of info would have been helpful.*

*RET participants need to know at least 2 to 3 months in advance what they will be researching. This will provide time to gain background information. The PI in charge of the assigned project needs to contact the RET participant immediately and suggest "homework" that will adequately prepare the participant upon arrival at the laboratory.*

Several respondents wanted more information about the RET Program itself, as distinct from information about their RET project. As two of the comments below indicate, some of the respondents had no idea that the Program they participated in was RET. (This may help to explain why 63 [12%] of the individuals contacted for the survey responded that they were not RET participants and therefore declined to complete the questionnaire.)

*Does the Principal Investigator have a welcome letter from NSF that can be read to the participants as to what the goals and objectives are of the NSF/RET?*

*This survey is the first I've heard of "Research Experiences for Teachers" as an outside entity, although I was informed that I was participating in a research experience for teachers. It might be a good idea to hear a two-minute summary of what the program is all about.*

*Was never told the funding came from RET, so I didn't know I was part of RET at the time. I'm guessing that my 2002 experience was the one funded by RET.*

## SUMMER ACTIVITIES

*I got to see real research at a research facility.*

*[We developed] a lesson plan bank of “real world” lessons.*

*[I learned] new ways to transfer engineering- and technology-based education to students.*

Although the RET Program was inspired by the Research Experiences for Undergraduates (REU) Program, participants’ activities in the two programs are quite different. The undergraduate experience focuses heavily on doing research, whereas the teacher experience focuses much more on watching, listening, and developing classroom plans. Thus, for example, 86% of REU Site participants but only 40% of RET participants reported that they collected and/or analyzed data or information to try to answer a STEM research question. Still, only 8% of RET participants (and 6% of REU participants) said that they “did little or nothing that seemed to me to be real research.”

Table III-3 shows the percentages of respondents who reported doing each of the 17 activities listed in the questionnaire. The three most common were: worked on a plan for applying aspects of what I learned in RET to my classroom teaching (79%), observed research activities performed by researchers/faculty at the host institution (79%), and prepared/delivered a poster presentation, written report, or oral presentation describing my RET accomplishments to other

Worked on a plan for applying aspects of what I learned in RET to my classroom teaching.....	79%
Observed research activities performed by researchers/faculty at the host institution .....	79
Prepared/delivered a poster presentation, written report, or oral presentation describing my RET accomplishments to other RET participants, my mentor, etc.....	75
Attended lectures about current topics/techniques in science, technology, engineering, or mathematics (STEM).....	74
Attended demonstrations of the use of scientific equipment or specific scientific procedures .....	74
Worked on developing curricula/lesson plans for my classroom .....	73
Practiced using scientific equipment or specific scientific procedures .....	73
Read academic literature, journal articles, etc.....	70
Assisted faculty/researchers with their research.....	58
Went on research-related field trips (to other labs on- or off-campus, industry research sites, outdoor research sites, etc.) .....	55
Did Internet searches on issues related to translating STEM topics to the classroom.....	53
Received formal or informal training in technical writing/presentation skills .....	44
Attended lectures/demonstrations/workshops about strategies for teaching STEM concepts.....	40
Collected and/or analyzed data or information to try to answer a STEM research question.....	40
Worked on a STEM research project for which I had major responsibility.....	33
Other major summer activities .....	6
Did little or nothing that seemed to me to be real research .....	8

Source: SRI International RET survey, 2004.

RET teachers, my mentor, etc. (75%). On average, participants were involved in about 9 activities (excluding “no real research”).

For about half of the activities, the level of participation varied significantly by summer of participation, and for most of these activities, participation rates were lowest for 2001 or 2002 participants and highest for multi-summer participants.<sup>3</sup> The largest differences were for working on a plan to apply what was learned to the classroom (reported by 65% of 2001/2002 participants, 81% of 2003 participants, and 98% of multi-summer participants) and doing Internet searches on issues related to applying what was learned to the classroom (reported by 35% of 2001/2002 participants, 57% of 2003 participants, and 69% of multi-summer participants).

## DURATION AND INTENSITY OF SUMMER ACTIVITIES

For most participants, RET summer projects entailed several weeks of intensive activities. The 2003 RET Program announcement states that RET summer projects should be at least 4 weeks long. In practice, 84% of participants said their project lasted at least 4 weeks; the average was 5.8 weeks. Most also reported that while the project lasted, it was essentially a full-time experience. On average, respondents worked 34 hours per week on RET.

Asked how many weeks they would have liked the RET summer activities to have lasted, considering their own needs, interests, time constraints, and so on, respondents reported an average of 5.6 weeks, only slightly below the 5.8 weeks they actually spent. Similarly, 93% of respondents said they thought the overall summer work load was “about right.”

## ACADEMIC YEAR FOLLOW-UP

Although follow-up is supposed to be a central element of RET, there was considerable variation in the amount of continuing contact between RET participants and their mentors or other faculty and graduate students with whom the participants interacted during the summer projects. With regard to the academic year following the 2003 summer, 9% reported no continuing contact, 22% reported “a little,” 29% reported “some,” 27% reported “quite a bit,” and 14% reported “a great deal.” Response distributions regarding follow-up following the 2001 and 2002 summers were very similar to those for 2003.

*[The most important impact of RET] has been the grad students coming into the classroom and doing hands-on demonstrations.*

*The professors were earnest in their support of my needs as a classroom teacher, and they were eager to share their expertise with me and my students.*

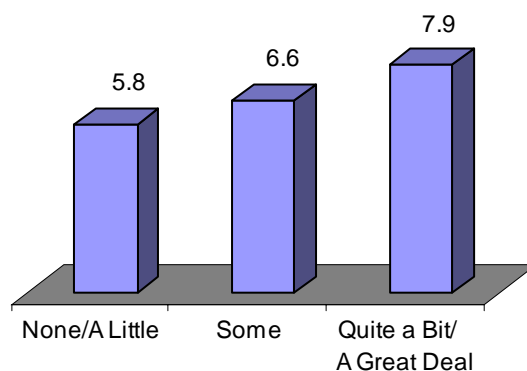
*I would like to see more of a commitment from the university or program for implementation of curriculum into my schools.*

As one might expect, there was a positive relationship between the amount of time spent on RET during the summer and amount of follow-up interaction. For example, those who reported quite a bit or a great deal of follow-up interaction spent an average of 7.9 weeks in RET activities during the summer, compared with an average of 5.8 weeks for those who reported no or a little interaction (Figure III-2).

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<sup>3</sup> For analyses by participation year, respondents were divided into three groups: summer 2001 or 2002 only (n=88), summer 2003 only (n=161), more than one summer (n=49). The relatively low activity participation rates among the 2001/2002 participants may be partly attributable to memory issues.

**Figure III-2**  
**Number of Weeks of Summer RET Activities,**  
**by Amount of Follow-up Interaction**



Source: SRI International RET survey, 2004.

## PARTICIPANTS' REPORTS OF THEIR RET EXPERIENCES

### Amount of Time Spent on Project Activities

Almost all participants indicated that their RET summer work load had been “about the right amount” and a majority also reported that they had spent about the right amount of time on several major types of activities (Table III-3). Participants were much more likely to report that they had spent too little time than too much time on hands-on research and curriculum development activities.

**Table III-3**

**2001-2003 ENG RET Participant Reports**  
**of the Amount of Time on Various Kinds of RET Summer Activities**  
**(Items are listed in descending order of “about the right amount”)**

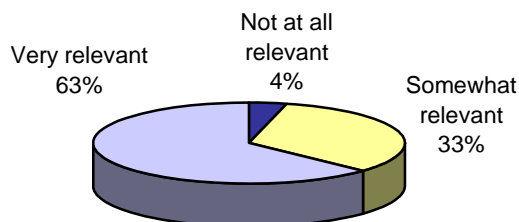
	<i>n</i>	Too Little	About the Right Amount	Too Much
Your summer RET work load overall	297	5%	93%	2%
The amount of time you spent attending lectures, workshops, demonstrations, and meetings	297	10	80	9
The amount of time you spent on hands-on research activities	297	21	76	3
The amount of time you spent on curriculum development or translating research experiences to the classroom	300	26	71	2

This table shows, for example, that 5% of the participants reported that their overall summer RET workload was too little.

Source: SRI International RET survey, 2004.

## Relevance to Classroom Activities

**Figure III-3**  
**2001-2003 ENG RET Participants' Reports**  
**of the Relevance of Their RET Activities**  
**to Subjects They Taught**



Source: SRI International RET survey, 2004.

Among participants who currently teach, 63% reported that, overall, the RET activities were “very relevant” to the subjects they currently teach, 33% said RET activities were “somewhat relevant,” and 4% said they were “not at all relevant” (Figure III-3). Participants who spent more than one summer in RET were considerably more likely than those who spent only one summer in the Program to indicate that the project was very relevant to their classroom (78% vs. 52%, respectively).<sup>4</sup>

## Satisfaction with the Program

*RET has been the most useful experience that I have ever had in education.*

*My experience was motivating and awesome.*

*I regret that my mentor was unskilled at this process, lacking in the skills necessary to guide a school teacher in the RET program.*

*[RET should] let us participate more in the lab. The PIs seriously underestimate the abilities and intellectual capabilities of some teachers.*

the roles and responsibilities of K-12 STEM teachers, his/her interest in helping them to develop a classroom plan, their opportunity to interact with researchers, and, especially, feeling as though they were an integral part of a research team. This last dimension, on which only 42% were very satisfied, corresponds with the relatively low percentage of participants who collected or analyzed data to answer a research question (40%).

To facilitate analyses of the relationship between satisfaction and other study variables, a factor analysis was conducted to identify satisfaction items that clustered together. This analysis led to the development of two indices, which we have titled “overall satisfaction” and “satisfaction with RET administrative issues.” Across all respondents, 59% were very satisfied overall, and 64% were very satisfied with RET administrative issues.<sup>5</sup>

Respondents were asked to rate their level of satisfaction with each of 13 aspects of their RET experience. Their responses are summarized in Table III-4. Participants were most satisfied with the adequacy of their stipend, the timeliness of their paychecks, the experience as a whole, and the helpfulness of the RET staff. On each of these four items, over 70% of the participants indicated that they were very satisfied. They tended to be less satisfied with such aspects of the experience as their mentor’s knowledge of

<sup>4</sup> We suspect that the causality works in both directions here. That is, participants whose activities were relevant to their classroom probably were more interested in returning for a second summer, and continuing participants were more likely than single-summer participants to work on translating their experiences to their classroom.

<sup>5</sup> Table III-4 shows which items are in each index. For each index, “very satisfied” indicates respondents who reported “very satisfied” on all items in the index.

**Table III-4**  
**2001-2003 ENG RET Participant Satisfaction**  
**with Various Aspects of the RET Experience**  
**(Items are listed in descending order of mean ratings)**

	<u><i>n</i></u>	<u>Mean</u>	<u>Very Dissatisfied</u>	<u>Somewhat Dissatisfied</u>	<u>Somewhat Satisfied</u>	<u>Very Satisfied</u>	<u>Doesn't Apply</u>
The adequacy of your stipend*	300	3.71	1%	3%	19%	76%	1%
The timeliness of your paychecks*	301	3.68	4	2	17	76	1
The experience as a whole**	299	3.66	1	4	23	72	<1
The helpfulness of the RET staff*	299	3.64	3	4	19	73	1
The helpfulness of graduate students and postdocs**	299	3.63	2	3	20	65	10
Your relationship with your mentor, overall**	300	3.63	4	5	17	74	1
How well organized the summer activities were*	298	3.48	4	7	26	62	1
The relevance of your RET experience to the subjects you teach**	299	3.46	3	7	30	59	1
Your opportunity to interact and discuss STEM issues with other teachers during the summer program**	299	3.41	4	8	27	55	6
Your mentor's knowledge of the roles/responsibilities of K-12 STEM teachers**	299	3.35	6	8	31	53	3
Your mentor's interest in helping you develop a plan to transfer what you learned to your classroom**	300	3.35	5	9	30	53	3
Your opportunity to interact and discuss STEM issues with faculty/researchers**	300	3.34	5	8	31	50	5
The extent to which you felt that you were an integral part of a research team**	301	3.15	8	12	35	42	4

This table shows, for example, that 1% of the participants were very dissatisfied with the amount of their stipend.

Note: Mean ratings are based on a 4-point scale in which 1 = very dissatisfied, 2 = somewhat dissatisfied, 3 = somewhat satisfied, and 4 = very satisfied.

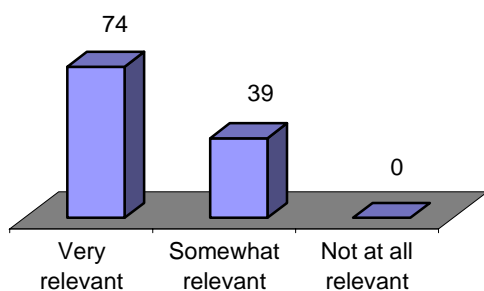
\*Part of the "satisfaction with administrative issues" index.

\*\*Part of the "overall satisfaction" index.

Source: SRI International RET survey, 2004.

## Correlates of Satisfaction

**Figure III-4**  
**Percentage of 2001-2003 ENG RET Participants Who Were Very Satisfied Overall with Their RET Experience, by Relevance of Their RET Activities to Subjects They Taught**



Source: SRI International RET survey, 2004.

The most powerful predictor of overall satisfaction with the RET project experience was the relevance of the participants' activities to the classroom subjects they taught: 74% of those who reported that RET was very relevant to their classrooms were very satisfied, compared with 39% of those who said RET was somewhat relevant, and 0% of those who said it was not at all relevant (Figure III-4).

Overall satisfaction also was strongly related to the number of project activities in which the respondent participated: 83% of those who participated in 13 or more of the listed activities were very satisfied overall, whereas only 34% of those who participated in 1 to 6 of the listed

activities were very satisfied. Of the various individual project activities, the following had the strongest relationships with overall satisfaction:

- Did little or nothing that seemed to me to be real research (only 21% of those who selected "did no real research" were very satisfied overall, compared with 64% of those who did not select this item).
- Worked on a plan for applying aspects of what I learned in RET to my classroom teaching (66% vs. 35% very satisfied).
- Worked on a STEM research project for which I had major responsibility (79% vs. 51% very satisfied).
- Collected and/or analyzed data or information to try to answer a STEM research question (77% vs. 49% very satisfied).
- Did Internet searches on issues related to translating STEM topics to the classroom (72% vs. 46% very satisfied).

Not surprisingly, multi-summer participants tended to be more satisfied with their experiences than were single-summer participants. (Presumably, they would not have returned if they had not enjoyed their first experience.) The dimension on which differences were the largest was the mentor's interest in helping develop a plan to transfer what was learned to the classroom. On this dimension, 80% of multi-summer participants were very satisfied, compared with 48% of single-summer participants. How well organized the summer activities were also was important, with 88% of multi-summer participants very satisfied, vs. 58% of single-summer participants.

### RET vs. REU Satisfaction

Percentages of RET and REU Site participants who were very satisfied with the experience as a whole were very similar (72% and 75%, respectively), as were the percentages very satisfied with how well organized the project was (62% and 59%) and the helpfulness of grad students and post docs (72% of those to whom the item applied). However, RET participants were

somewhat less likely than the REU undergraduates to be very satisfied with the extent to which they were an integral part of a research team (42% vs. 54%).<sup>6</sup>

## **SUMMARY OF PARTICIPANTS' RET EXPERIENCES**

The typical RET participant engaged in a full-time 6-week experience for a single summer (most commonly in 2003), during which time he/she commuted to a 4-year college or university. All respondents had some kind of pre-project contact, most often phone calls or e-mails. Although a large majority considered themselves to be “pretty well” or “very well” informed about various aspects of the project/Program, fewer than a third said that they very well informed about all aspects.

Relative to the typical undergraduate research experience, the RET experience focused much more on watching, listening, and developing classroom plans than on hands-on research. For example, 79% worked on classroom plans, and 79% observed faculty research activities, but only 40% collected or analyzed data to try to answer a research question.

The extent of academic-year follow-up by RET faculty and staff varied. Fewer than half (39%) reported “quite a bit” or “a great deal” of follow-up, and 11% said there was none.

Far more respondents thought that there was too little time rather than too much time spent on hands-on research and curriculum development, but most indicated that the amount of time on these activities was “about right.” About 7 in 10 were very satisfied with the experience as a whole, but only about half were very satisfied with their mentor’s knowledge of the roles and responsibilities of K-12 STEM teachers or with their mentor’s interest in helping them develop classroom plans. Overall satisfaction was strongly related to the experience’s relevance to subjects taught in the classroom, to having participated in a variety of project activities, and to having done at least something that seemed like “real research.”

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<sup>6</sup> The four items noted here were the only satisfaction items common to the two surveys.

## IV. RET OUTCOMES AND IMPACTS

### PROJECT OUTCOMES

Survey respondents were asked whether they had experienced each of a total of 42 different possible RET outcomes, ranging from increased awareness of current STEM research issues, to increased use of hands-on activities in the classroom, to the assumption of new leadership roles or responsibilities as a result of the RET experience (Table IV-1). Twenty-seven of the listed outcomes were reported by more than half of the respondents, and 12 were reported by more than three-fourths, indicating that the Program overall had a wide variety of positive effects. The most common effects—reported by about 9 in 10 or more participants—were increases in participants’ STEM knowledge base, awareness of STEM research issues, motivation to find ways to improve student learning, and ability to convey the excitement of STEM to students.

<b>Table IV-1</b>		
<b>2001-2003 ENG RET Participant Outcomes: Percentage Who Reported Each RET Outcome (Outcomes listed in descending order of percentage who reported them)</b>		
	<b>Percentage</b>	<b>Percentage Increased “A Lot”**</b>
Increased my general knowledge base in STEM	98	55
Increased my motivation to find ways to improve my students’ learning	94	60
Increased my ability to convey the excitement/vitality of STEM to students	89	49
Increased my awareness of current STEM research issues	88	45
Increased my confidence in my ability as a STEM teacher generally	87	43
Increased my professional opportunities	81	36
More since RET: assign projects based on “real world” problems	81	na
Included examples or applications from my RET activities in my teaching	81	na
More since RET: tell students about or use new technologies	80	na
Increased my awareness of new materials/equipment (other than computers) that could be useful to me as a teacher	77	35
Increased my understanding of how to conduct a research project	77	31
More since RET: integrate math, science, and technology	77	na
Increased my understanding of STEM applications in everyday life	74	29
Increased my understanding of how scientific knowledge is built	73	28
More since RET: use hands-on activities in my classroom	72	na
Increased my skills in using the Internet to obtain information that will be helpful to my teaching	67	21
Increased my understanding of how to deal with research setbacks, frustration, “negative results,” etc.	66	25
More since RET: assign joint or group projects	65	na
Acquired new skills in RET that I was able to use in my classroom	65	na
Increased my awareness of how to use computers more effectively in my teaching	64	23
<i>(continued)</i>		

**Table IV-1 (concluded)**

**2001-2003 ENG RET Participant Outcomes: Percentage Who Reported Each RET Outcome  
(Outcomes listed in descending order of percentage who reported them)**

	<u>Percentage</u>	<u>Percentage Increased “A Lot” *</u>
More since RET: use computers	64	na
More since RET: require oral presentations or written reports	62	na
Implemented in classroom curricula/lesson plans developed as part of RET activities	61	na
More since RET: talk with or counsel students about careers in STEM fields	59	na
Increased my awareness of STEM career options	57	22
Increased my understanding of ethical dimensions of STEM research	56	20
Have shared RET-derived information, materials, or other resources with other teachers in my school/district	53	na
Increased my awareness of magazines/professional journals that could be useful to me as a teacher	48	14
Received materials, supplies, or equipment from my RET institution that I have been able to use in my classroom	48	na
More since RET: encourage students to access the Internet to learn more about STEM topics	39	na
Used contacts or experiences from RET to obtain new resources for my classroom	39	na
As a result of my RET experiences, I began teaching additional/different subjects than I did before my RET experiences	37	na
More since RET: take students on field trips to research labs/facilities	32	na
More since RET: read scientific/engineering journal articles	31	na
More since RET: became involved in STEM-related extracurricular activities (e.g., school science club)	29	na
During the academic year(s), I have networked with other RET teachers about teaching or other professional issues	28	na
Faculty/researcher(s) from my RET institution came to my school to meet with my students (gave presentations, counseled about careers, etc.)	26	na
As a result of my RET experiences, I assumed new leadership roles or responsibilities in my school/district/region	18	na
Took students to my RET college/university	17	na
Have organized/facilitated in-service workshops for other teachers/school personnel on issues related to my RET experiences	16	na
Developed partnership between my school and RET college/university as a result of RET	11	na
As a result of my RET experiences, I changed jobs	1	na

\*Percentage who reported that their awareness/understanding increased “a lot,” given the options of “none,” “some,” or “a lot.” Items with “na” in this column did not include an “increased a lot” response category.

Source: SRI International RET survey, 2004.

## Outcomes Indices

To reduce the number of variables to a more manageable number and facilitate assessments of effects, factor analyses of the outcomes items were conducted.<sup>7</sup> Items that were statistically correlated with one another and conceptually similar were combined into an index, resulting in a total of 10 indices, each comprising between 2 and 8 survey items. These indices are summarized below.<sup>8</sup>

**New Teaching Strategies** (8 items). Assign more projects based on “real world” problems, assign more group/joint projects, implemented curricula developed in RET, etc.

**Increased Teaching Capabilities** (6 items). Ability to convey excitement of STEM to students, confidence in abilities as STEM teacher, understanding of STEM applications in everyday life, and so on.

**Computers/Technology** (5 items). Increased awareness of how to use computers effectively in teaching, increased use of computers in the classroom, and so on.

**Increased Research Knowledge** (5 items). Understanding of how to conduct a research project, how scientific knowledge is built, ethical dimensions of STEM research, and so on.

**STEM Career Awareness** (2 items). Do more talking with or counseling of students about STEM careers, greater awareness of STEM career options.

**New Materials** (2 items). Received materials from RET for classroom, used RET contacts or experiences to obtain new classroom resources.

**STEM Publication Awareness** (2 items). Greater awareness of STEM journals useful to teachers, read more STEM journals.

**New Activities/Opportunities** (5 items). As result of RET, began teaching new subjects, involved in STEM club, new leadership roles, and so on.

**Networking and Sharing** (4 items). Networked with other RET teachers, shared RET information/materials with others in school, developed IHE/school partnership, and so on.

**Research-Related Visits** (3 items). Take students on field trips to research labs or RET institution, RET faculty/researcher visits classroom.

To make the scores of the various indices comparable, given that the indices were composed of different numbers of items, an individual’s score was calculated as the percentage possible for that index, so that each index ranged from 0 (did none of the activities in that index) to 100 (did all of the activities in that index). The overall index score was then calculated as the mean of the individual scores.

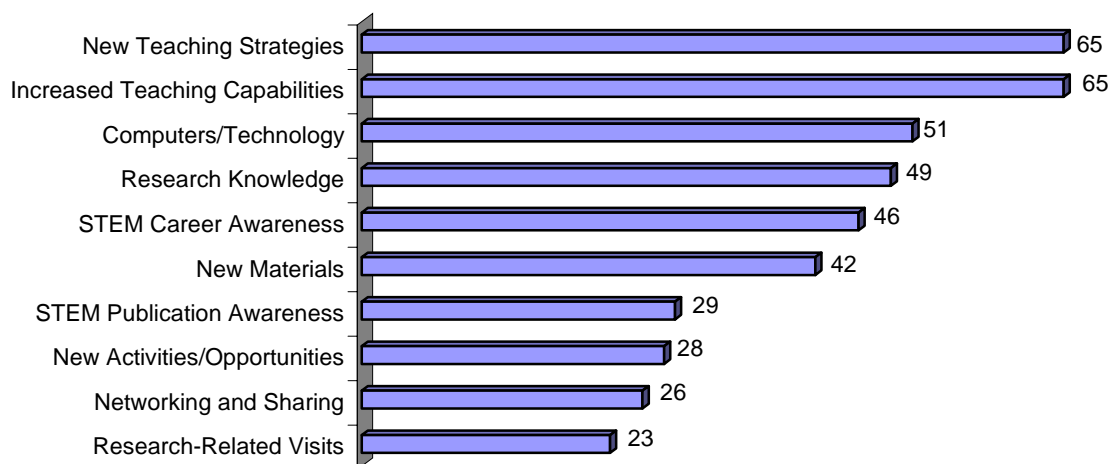
Figure IV-1 shows the mean score for each outcomes index. Overall, the most widespread RET impacts were related to increased teaching capabilities and new teaching strategies. The mean scores for these indices were 65, indicating that, on average, teachers experienced 65% of

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<sup>7</sup> Because we wanted the respondent group to be the same for all items in the outcomes indices, only respondents who were teachers both before RET and at the time of the survey (n = 272) were included.

<sup>8</sup> The survey items comprising each index are presented in Appendix B.

**Figure IV-1  
2001-2003 ENG RET Outcomes Scores\***



\*Individuals' outcome scores range from 0 (did none of the activities in that index) to 100 (did all of the activities in that index). Reported here are the means of all respondents' scores.

Source: SRI International RET survey, 2004

the various outcomes related to increased teaching capabilities and new teaching strategies. Least common outcomes were increased networking and sharing of information or materials (with a score of 26) and visits to the RET site or from RET participants (23).

### **Respondent Descriptions of Most Important Project Outcomes<sup>9</sup>**

Respondents were asked to describe what they thought was the single most important outcome of their participation in the RET Program. Broadly speaking, responses were consistent with the findings from the closed-ended questions about outcomes. For example, the largest category of responses described how RET enabled respondents to be better teachers.

*My work was in robotics—I have been able to bring very motivating activities to my inner-city students. It has challenged me to think of ways to incorporate STEM into the social studies classes that I teach.*

*Learning true research methods and being able to use these skills to motivate students to do their own research in the classroom.*

*I feel very confident in my ability to think and act like a scientist and it's given me more confidence as an upper-level chemistry teacher.*

*Obtaining the resources, confidence, and deeper understanding that I needed to teach physics in a very effective and intellectually stimulating way.*

<sup>9</sup> The questionnaire included two open-ended questions about effects of participants' RET experiences: one about program outcomes and another about impacts of the program on participants' students and school or school system. There was considerable overlap in the nature of the responses to these two questions. For simplicity of presentation, in this section we relate responses about the effects of the program on the teachers themselves; responses that refer explicitly to the participants' students or schools are summarized below, in the section titled "RET Impacts."

*The opportunity to be back on a university campus and networking with scientists and their grad students was a special treat for renewal during the summer. Also, to be a “student” instead of preparing for other learners was a great way to rekindle enthusiasm and infuse the newest info/techniques into my upcoming high school lesson presentations!*

*The ability to counsel my students as to the opportunities available in the real world and allow them the opportunity to simulate those activities in the high school classroom. So much more...*

Comments about new STEM knowledge and the opportunity to learn about or, in some cases, do research also were common.

*I sincerely believe the RET program has exposed me to area of STEM that I would NEVER have been involved in. This is exciting for me because I am learning along with my students. The excitement is contagious.*

*I think the single most important outcome of participation in RET was a better knowledge of how science is used in the real world, and how the STEM skills can be applied to problem solving in all areas of life.*

*We were able to complete a DNA strand for the first time. And we also were able to preserve enough chromosome slides to last for a year.*

*I have learned many more advanced computer skills which make planning lessons, creating Word documents to accompany lessons, and PowerPoint presentations for class much more exciting for the students.*

*Awareness of the cross-disciplinary approach to nanotechnology studies.*

*My awareness of the logisticians role in the military research facility.*

Some described new contacts and networking or professional development opportunities.

*From this experience I have copublished twice, regularly collaborate with area colleges, improved my courses, and instructed fellow K-12 teachers in the design process in our state curriculum frameworks.*

*The chance to begin networking with professionals in the STEM fields so I can enhance my teaching skills and resources.*

*Made a good contact with my mentor so that I can take my students to see a college engineering environment. Exposure to other highly motivated teachers.*

*Connections with grad students and having them come to our school and work with our students.*

*Ability to work with people from other disciplines.*

A few described greater STEM education and career awareness.

*It made me more aware of some of the new STEM challenges on the horizon and more capable of exciting my students about STEM careers.*

*Awareness of university opportunities and goals. I have a better idea of what universities are wanting from students and what expectations they have of the*

*students. I also appreciate the opportunity to communicate and interact with university professors on a professional level.*

*Awareness of engineering career options.*

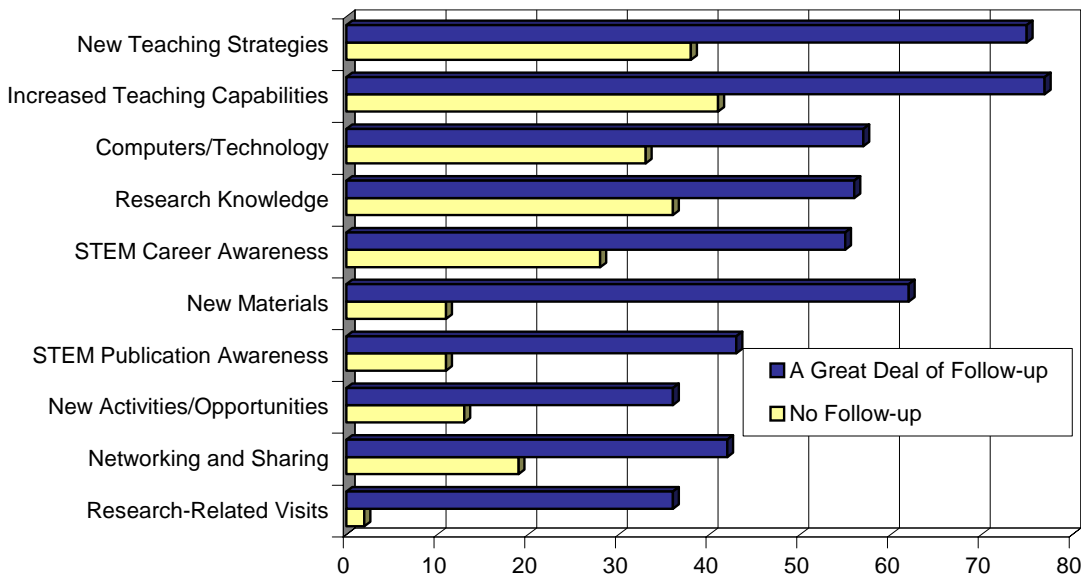
*Exposure to the skills that are required from STEM courses to go out and succeed in various STEM occupations is the single most important outcome to me. Now I can relay this information to my students.*

### Key Correlates of Project Outcomes

Project outcomes were strongly related to amount of follow-up interaction, the project’s relevance to participants’ classroom subjects, and the variety of project activities in which the participant engaged. For all outcomes indices, mean scores progressed from lows among participants who reported no follow-up/low relevance/few activities to highs among those who reported a great deal of follow-up/high relevance/many activities.

Figure IV-2 shows the relationship between the outcome indices and the amount of follow-up interaction. Outcomes most strongly related to follow-up were New Teaching Strategies, Increased Teaching Capabilities, and, especially, New Materials. For example, New Materials mean scores ranged from 11 among those who reported no follow-up to 62 among those who reported a great deal of follow-up, and Increased Teaching Capabilities means ranged from 41 to 77, respectively.

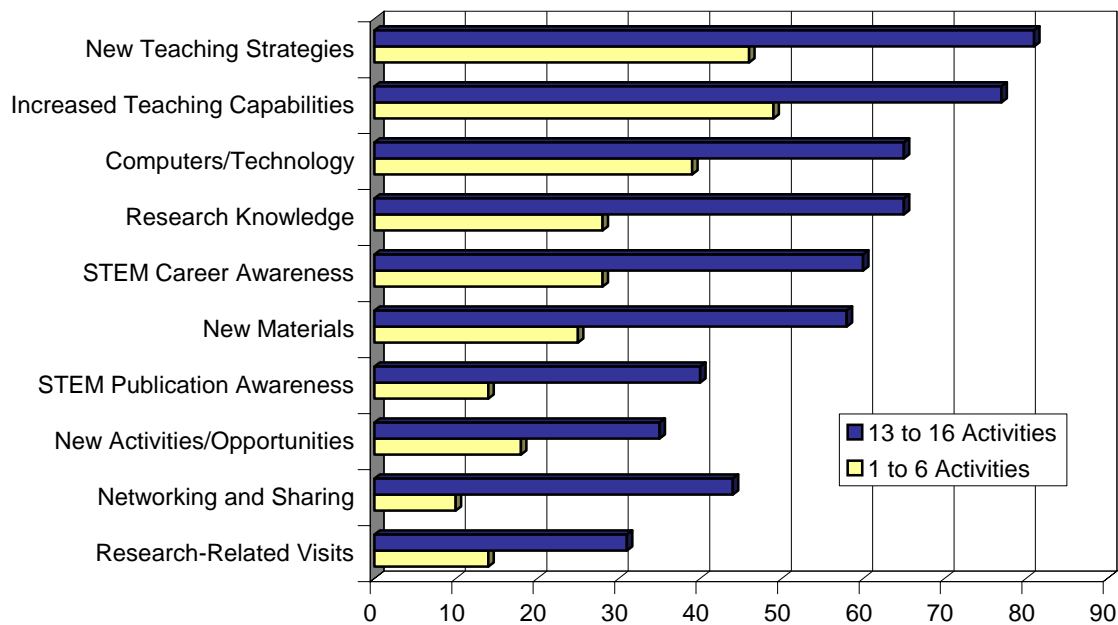
**Figure IV-2**  
**2001-2003 ENG RET Project Outcome Scores, by Amount of Follow-up Interaction**



Source: SRI International RET survey, 2004.

The relationship between the outcome indices and the number of different kinds of RET summer activities is shown in Figure IV-3. Outcomes most strongly related to number of activities were Research Knowledge, New Teaching Strategies, and New Materials. Research Knowledge mean scores, for instance, ranged from 28 among participants who engaged in 1 to 6 different kinds of activities to 65 among those who engaged in 13 to 16 activities.

**Figure IV-3**  
**2001-2003 ENG RET Outcome Scores,**  
**by Number of Activities in Which RET Teachers Participated**



Source: SRI International RET survey, 2004.

Figure IV-4 shows the relationship between the outcome indices and the relevance of RET summer activities to subjects taught by participants. New Materials, New Teaching Strategies, and Increased Teaching Capabilities were the indices most strongly related to relevance. New Materials means ranged from 0 among those who thought their RET activities were not at relevant in their classroom<sup>10</sup> to 52 among those who thought RET was very relevant, and New Teaching Strategies means ranged from 29 to 73 for these two groups.

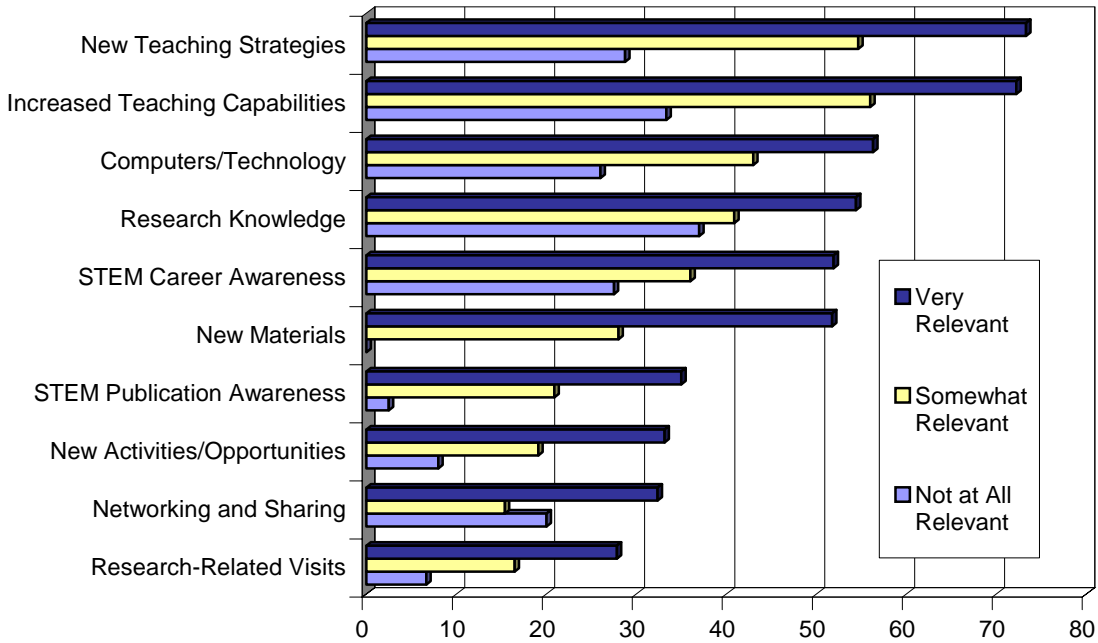
### Outcomes by Project, School, and Teacher Characteristics

RET outcomes were analyzed by the following project, school, and teacher characteristics:

- Project characteristics
  - Summer of project participation (2001 or 2002, 2003, multi-summer)
  - Total hours in project (<121, 121-200, 201-280, >280)
- School characteristics
  - School location (urban, suburban, rural)
  - School level (elementary/middle vs. high school)
  - Subsidized lunch program (50% or fewer vs. >50% of students receive reduced price/free lunch). (This measure is a proxy for low income students.)

<sup>10</sup> As noted in Chapter III, only 4% of respondents reported that RET was not at all relevant to their teaching.

**Figure IV-4**  
**2001-2003 ENG RET Outcome Scores, by Relevance**  
**of Program Activities to Subjects Taught by RET Participants**

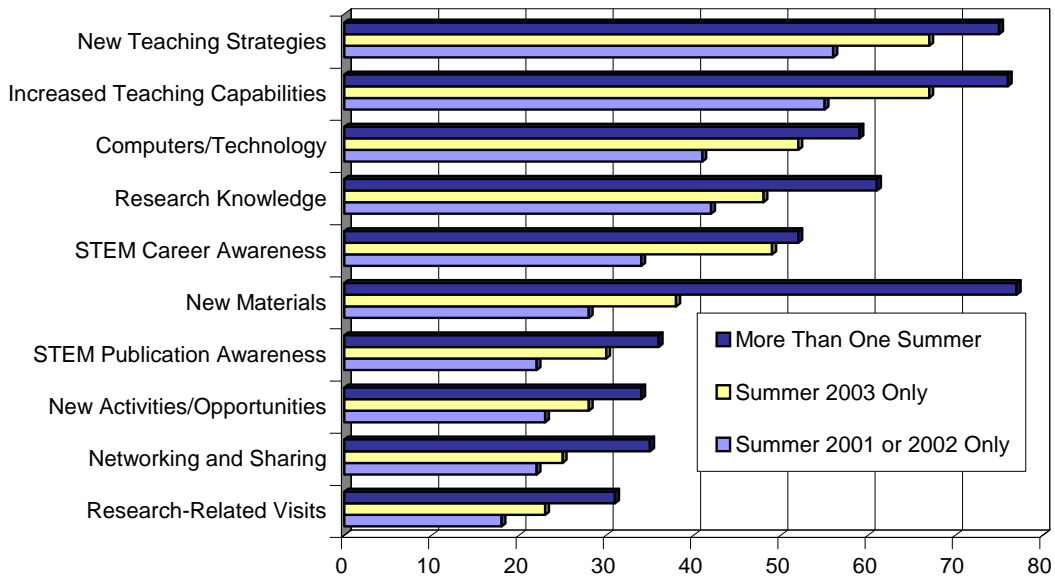


Source: SRI International RET survey, 2004.

- Teacher characteristics
  - Years teaching (10 or fewer vs. >10 years)
  - Any STEM degree area
  - Highest level education received (undergraduate vs. masters or higher)
  - Age (<40 vs. 40+)
  - Gender

Of these characteristics, “summer of project participation” is the only one that is statistically reliably related to most of the outcome indices. The other characteristics tend to be related to only two or three indices, and the differences between high and low groups are small. In contrast, the “summer of project participation” groups are reliably different from one another on all but one of the indices (Research-Related Visits), with those who participated for more than one summer typically having the highest scores and those who participated only in 2001 or 2002 having the lowest scores (Figure IV-5). As with the relationships of the outcomes to the amount of follow-up, numbers of activities, and classroom relevance, the differences here are especially large with regard to New Materials, and there also are sizeable differences relating to New Teaching Strategies, Research Knowledge, and Teaching Capabilities.

**Figure IV-5**  
**2001-2003 ENG RET Outcome Scores, by Summer of Participation**



Source: SRI International RET survey, 2004.

## Relationships Between RET Activities and Outcomes

Of the various RET summer project activities (listed in Table III-1, above), working on a plan to apply what was learned in RET to the classroom was the most strongly related to most of the outcome indices. For example, those who worked on a classroom plan had a mean New Teaching Strategies score of 72, whereas those who did not work on a classroom plan had a mean of 43. The activities next most strongly related to outcomes were “did Internet searches on issues related to translating STEM topics to the classroom” and “attended lectures/demonstrations/workshops about strategies for teaching STEM concepts.” The activities least likely to be related to outcomes are training in presentation skills, giving a presentation or writing a report, and assisting faculty with research. Having done “no real research” was not particularly strongly related to outcomes but was very strongly related to satisfaction.

## PROJECT IMPACTS

### RET Impacts on Students

Respondents were asked how, if at all, any of their students had been affected by changes in the respondent’s teaching following his/her RET experiences. The vast majority (83%) of respondents indicated that their participation resulted in one or more types of student effects. Most common were increased students’ awareness of STEM career options, more positive attitudes about STEM subjects in general, and greater interest in the respondent’s classes (Table IV-2).

**Table IV-2**

**2001-2003 ENG RET Teachers' Reports:  
Effects on Students from RET-Induced Changes in Participants' Instruction**

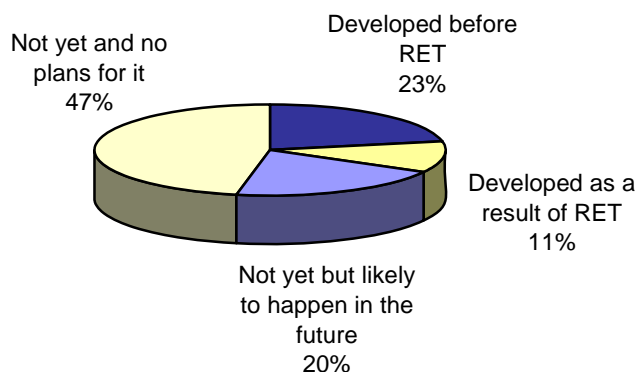
They have become more aware of STEM career options	56%
They have more positive attitudes about STEM subjects in general	53
They are more interested in my classes	52
They have become more interested in STEM careers	43
They are less intimidated by STEM subjects	39
They are doing a better job of learning STEM subjects	36
They have started/joined a STEM club	14
They have participated in research at my RET institution	12
Other RET effects on my students	5
None of the above	5

This table shows, for example, that 56% of RET teachers reported that their students have become more aware of STEM career options since the respondent participated in RET.

Source: SRI International RET survey, 2004.

## Partnerships Between K-14 Schools and Four-Year Colleges/Universities<sup>11</sup>

**Figure IV-6**  
**Partnerships Between Colleges/Universities and  
2001-2003 ENG RET Participants' Schools/Districts  
to Improve K-14 STEM Education**



Source: SRI International RET survey, 2004.

As stated in NSF's FY 2001 request for proposals, the Program's goal is to help build long term collaborative relationships between K-14 teachers of science and mathematics and the NSF research community. To assess progress toward this goal, the survey asked whether partnerships to improve K-12 STEM education had been developed between the respondent's school or district and a college or university prior to the respondent's participation in RET or as a result of RET participation. About half of the respondents reported that there was an existing partnership, one developed as a result of their RET participation, or one likely to be developed in the future (Figure IV-6).

<sup>11</sup> RET research was conducted in commercial and non-profit organizations and federal research laboratories as well as in four-year colleges and universities. However, because the vast majority of ENG RET teachers worked in four-year colleges or universities, the questionnaire asked only about partnerships with colleges or universities.

## Descriptions of Most Important RET Impacts on Students and Schools

Respondents were asked to describe what they thought was the most important impact, if any, that their participation in the RET Program had on their students or their school/school system. The most common responses related to increased student confidence, awareness, and interest in STEM topics and careers.

*The biggest impact was when my students started telling students on the other teams about their “cool” activities. The other teachers then came to me to learn about the activities, including how to use the equipment. I wound up teaching the activities to the other teams while they covered my classes. So instead of just reaching my students, I was able to connect with the entire eighth grade, approximately 400 students.*

*The single most important outcome was bringing the world of engineering to some of my at-risk students. Engaging them in meaningful activities and watching them make connections to the mathematics they are learning was very rewarding. They appreciated the change of pace in the classroom, and I enjoyed teaching them something brand new.*

*My students learn about topics that affect them and their families and they become aware of careers they might be interested in in the future.*

*My students are better able to ask questions; they search for the answers and are confident enough to present their answers regardless of what they found.*

*My excitement was/is contagious. Kids are more interested to see what I’m all excited about.*

*I teach science to all fifth graders. I received many notes and comments from students this year telling me that this is the first year they have liked science.*

A number of respondents commented on increased hands-on and “real world” STEM experiences for their students or noted specific new materials or topics.

*The completion of a project on bridge building. That encouraged several female students to consider engineering as a major.*

*Students applied their math skills to real world science projects that became their science fair projects.*

*My students loved the interactive activities. It was very hands-on and they loved learning that way.*

*My advanced placement students became involved in the research project I was involved in.*

For some, the new link or increased involvement with the RET institution or other colleges/universities was the most important impact.

*Because we had a graduate student we were able to bring in neat labs and run an after-school program. This opened the eyes of students so they could see and hear about someone doing real research. Also my students took a tour of the university*

*and the program I was involved in. This was a great opportunity for them to be exposed to STEM in the real world.*

*We have been able to place high school students in research labs to work with RET faculty mentors.*

*I now regularly collaborate with faculty and staff at three area colleges.*

In some cases, RET led to new programs or curricula.

*Since my new position stemmed from my participation in the RET I have been able to work with the local K-12 community and sponsor many beneficial programs. I also organize lab tours for many of the RET participants' students so that they have a better understanding of engineering applications.*

*I began to think how to present more of my new-found information to as many students as possible. A science teacher who also was in the RET program wrote a proposal for a math, science, and technology after-school program to involve more grade-level and underachievers interested in math and science careers.*

*I gained expertise required to initiate a robotics elective that has continued to be successful.*

*It gave me background experience to become the science coordinator, which the school had never had before.*

*We are implementing a science program based much more in doing science than in reading about science. The RET program has helped me and worked with me to develop this plan.*

*The partnership with the [RET university] has helped me create a summer camp to encourage middle school students to seek engineering careers.*

### **Correlates of RET Impacts on Students**

Teachers who reported many student effects were more likely to have participated in a variety of RET activities, to have experienced many personal outcomes, and to be more satisfied with their RET experience than were teachers who reported no or only a few student effects. Examples of these differences are presented in Table IV-3.

**Table IV-3**  
**2001-2003 ENG RET Teacher Activities and Outcomes**  
**by Number of Student Effects from RET Participation**

	<b>Teachers Who Reported 5 to 8 Student Effects</b>	<b>Teachers Who Reported No Student Effects*</b>
	<i>(n = 42)</i>	<i>(n = 70)</i>
Average number of RET activities	10.8	7.2
Mean New Teaching Strategies index score	84	30
Mean Increased Teaching Capabilities index score	80	40
Mean New Materials index score	71	13
Percentage very satisfied with the overall RET experience	83	19

This table shows, for example, that teachers who reported 5 to 8 student effects participated in an average of 10.8 RET activities. See Table IV-2 for a list of the various types of student effects asked about.

\*This group includes those who said that RET did not change their teaching.

Source: SRI International RET survey, 2004.

## OBSTACLES TO IMPLEMENTATION

Teachers were asked to rate each of nine potential obstacles in terms of how much of an obstacle it was to their ability to transfer what they learned in RET to their classroom (Table IV-4). By a considerable margin, the high cost of materials and equipment was overall the biggest obstacle, rated as a major obstacle by 43% of respondents and as a minor obstacle by another 31%. The next biggest obstacle overall was not having enough time to prepare new lesson plans, rated as a major obstacle by 24% and a minor obstacle by 41%. Resistance by administrators or other teachers was relatively uncommon, with only 5% rating each as a major obstacle.

To assess the relationship between obstacles and other study variables, we created an overall obstacles index by calculating each respondent's mean response to all nine potential obstacles.<sup>12</sup> Predictably, teachers who experienced none or few of the listed obstacles tended to have higher outcomes scores than other teachers for the three indices most directly related to classroom implementation: New Teaching Strategies, Increased Teaching Capabilities, and Research-Related Visits. However, the differences are not as large as one might have thought. For example, the mean Increased Teaching Capabilities scores for teachers who experienced none/a few obstacles, some obstacles, and many obstacles were 71, 67, and 62, respectively. The extent of obstacles experienced also was related to the relevance of RET activities to the classroom. However, the extent of obstacles experienced was not related to satisfaction with the RET experience or the amount of follow-up interaction.

<sup>12</sup> The index scores were divided into three groups, as follows: no/few obstacles = 1.0 to 1.39; some obstacles = 1.4 to 1.9; many obstacles = 2.0 to 3.0.

**Table IV-4**  
**Obstacles to Transferring RET Knowledge to the Classroom**  
**Reported by 2001-2003 ENG RET Teachers**  
**(Listed in descending order of mean rating)**

	<i>n</i>	Mean*	Not an Obstacle	A Minor Obstacle	A Major Obstacle	Have No Idea
Materials, equipment, etc. are too expensive	258	2.22	22%	31%	43%	3%
Not enough time on your part to prepare new lesson/lab plans, etc.	258	1.91	33	41	24	2
The level of the science is too high	262	1.78	41	37	19	3
Materials, equipment, etc. that you are planning to use are not yet available	257	1.74	44	27	20	9
The scientific topics are too different	260	1.72	42	40	15	3
The school's curriculum is inflexible	257	1.67	51	28	19	3
School has poor/no access to computers/Internet	260	1.57	58	25	15	2
School administrators are resistant to your proposed changes	256	1.30	70	17	5	7
Other teachers resent or don't support your proposed changes	254	1.28	72	16	5	7

This table shows, for example, that 22% of respondents indicated that the expense of materials and equipment was not an obstacle to their ability to transfer what they learned in RET to their classroom.  
Based on a 3-point scale where 1 = not an obstacle, 2 = a minor obstacle, and 3 = a major obstacle.  
Source: SRI International RET survey, 2004

**SUMMARY OF RET OUTCOMES AND IMPACTS**

Participation in the RET Program served to increase almost all participants’ STEM knowledge base and awareness of STEM research issues, and it increased their motivation to find ways to improve student learning and their ability to convey the excitement of STEM to students. More than 80% also reported positive effects on their students, the most common of which were increased awareness of STEM career options, more positive attitudes about STEM subjects in general, and more interest in the respondent’s classes.

Participants who reported that the RET experience was very relevant to subjects they taught in the classroom were considerably more likely than those for whom the experience was only somewhat or not relevant to have reported diverse positive outcomes and effects on their students. Positive outcomes also were strongly related to the amount of follow-up interaction experienced, overall satisfaction with the experience, and the variety of project activities undertaken. Participants who were involved with the Program for more than one summer also reported more diverse and powerful outcomes than did those who were involved for a single

summer. There were few appreciable relationships between school or participant characteristics and project outcomes. The most common obstacle to transferring what was learned in RET to the classroom was the expense of materials and equipment.



## V. PARTICIPANT SUGGESTIONS FOR PROJECT/PROGRAM IMPROVEMENT

Approximately 4 in 10 respondents (37%) provided suggestions on how the RET Program or their RET projects might be improved.<sup>13</sup> Suggestions included more or clearer information about project activities, objectives, and participant responsibilities; more or better interaction with mentors; more or less of different kinds of project activities; greater attention to RET's relevance to the classroom; more support for classroom implementation; opportunities for continued involvement in the Program; and Program expansion. Examples follow.

### **MORE OR CLEARER INFORMATION ABOUT PROJECT ACTIVITIES, OBJECTIVES, AND PARTICIPANT RESPONSIBILITIES**

*It needs to be advertised/set up so that teachers are selected in January or February so that they do not take other summer jobs.*

*Better and timely communication with urban public schools to recruit more teachers of large minority urban schools.*

*Please have the funding on time. I began my RET with no assurance that the funding would follow. I worked almost the whole summer before seeing any of the funding.*

*Specific goals need to be outlined from the start. Teachers need to know the specific steps for lesson plan development, implementation, and what is expected of them.*

*Better organize the summer program. Too much time wasted waiting for an administrator/mentor to make a decision before programs could proceed.*

*More of an explanation of what it truly is all about.*

### **MORE OR BETTER INTERACTION WITH MENTORS**

*My mentor was not around a lot and did not provide clear training for me; the graduate students did not have time or were not interested in training me, so I was often left with things that I did not understand.*

*I regret that my mentor was unskilled at this process, lacking in the skills necessary to guide a school teacher in the RET program.*

*My assigned researcher in one of the engineering departments showed minimal interest in helping my partner and me.*

*I have talked to other RET participants in other programs and we all feel that the PIs are just "humoring" us to get their NSF grants. We know they need to have a K-12 component and just having us in the lab satisfies that requirement.*

*The RET people need to be friendlier and treat us as professionals.*

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<sup>13</sup> These counts do not include suggestions for improving the project orientation meetings and materials, discussed in Chapter III.

## **MORE OR LESS OF DIFFERENT KINDS OF PROJECT ACTIVITIES**

*Actually doing research (not Internet based) would have made it better.*

*Let us participate more in the lab. The PIs seriously underestimate the abilities and intellectual capabilities of some teachers.*

*Have teachers actively participate in real research.*

*More software training.*

*Bigger supplies budget based on lesson development for the classroom.*

*Get rid of the poster project; it seems to me a waste of valuable time that could be used for lesson creation.*

## **GREATER ATTENTION TO RET'S RELEVANCE TO THE CLASSROOM**

*As much as possible, much prior matching of curriculum to research should be done.*

*Better communication between PIs and participants. Don't put a RET participant who teaches biology into a technology laboratory.*

*Please consult high school teachers when planning these summer programs. Ask high school teachers what they need to help them in the classroom.*

*I do believe that more decisions upon the part of the participants is necessary in developing the protocols and improving the research.*

*RET teachers should guide a group of teachers new to RET through the process and serve as mentors to the new teachers.*

*I would have had it much easier if I had had a science teacher from my school as a partner and then we later focused on taking it to other schools in our district.*

*Most professors there did not have any familiarity with teaching at the public school level, thus making it difficult for them to translate their research into lessons or plans that can be used in the classroom.*

## **MORE SUPPORT FOR CLASSROOM IMPLEMENTATION**

*Provide resources to implement the activities that teachers develop and continue to support them as they continue to use those activities. Otherwise, teachers are the only ones to benefit from the experience and not the students and school.*

*More emphasis on helping teachers connect these experiences to their teaching. Help with continuing the research so students can participate.*

*Participants need to have year-round contact with professors/mentors and access to facilities.*

*Connect what we are learning in the lab into real life applications in the classroom. The two seemed so disconnected at the time.*

*[The program has to outline] how the research is going to be utilized in a classroom structure for high school students.*

*Meet with previous participants to hear of their experience and how they used their experience in the classroom.*

*Let teachers know if their assigned research topic can be transitioned into a classroom project.*

## **OPPORTUNITIES FOR CONTINUED INVOLVEMENT IN THE PROGRAM**

*I did my RET in the summer of 2002. I would have like to be able to continue with this training and experiences in the following summers but I was not contacted and was not able to do it again, even though I would have done it in a minute.*

*It must last longer than one summer.*

*It would be nice to have RET reunions so that past teachers can get together and share what they've learned and what they've done in their RET experiences.*

*The program that I participated in was outstanding and I would like to continue working with it.*

*I would love to have an opportunity to do a summer RET experience again in the same area and keep learning more to take students to even higher learning.*

## **PROGRAM EXPANSION**

*There are other schools that are on a year-round schedule as I am. Perhaps this program could be offered at various times throughout the year so other teachers can have this experience to increase their ability to participate in the lab of their choice and to get more teachers involved in STEM activities.*

*I think that you should have a program for administrators/curriculum people as well as teachers. I also would like to see a program that follows up throughout the school year.*

*This is a great program and I hope that the scope of the program grows and more teachers will be informed about its existence.*

*More teachers need to do it! More publicity! More colleges and universities buying into the program!*



## VI. RECOMMENDATIONS

The ENG RET Program has been effective in teaching K-14 STEM teachers more about STEM research and motivating them to convey their newfound enthusiasm to their students. But even highly effective programs can be more effective. SRI's suggestions for achieving this end follow.

- It appears that a number of ENG RET participants were not aware that they were participating in RET. Accordingly, we suggest that NSF prepare a brochure briefly describing the Program and require that RET PIs distribute it to all participants. Such a description will serve several purposes:
  - It will increase participants' awareness that the RET Program exists and that it is NSF that is sponsoring their activities.
  - It will increase participants' understanding of the Program's objectives and of the required/recommended components of the Program.
  - It may also serve as a reminder to the PIs of the Program's requirements and recommendations.
- Numerous requests and reminders were required obtain RET-participant contact information from the PIs, and even after all the requests, contact information was obtained for only about two-thirds of the total estimated number of participants. Many reminders also were required to obtain participants' survey responses. We suggest that NSF facilitate future Program evaluations through the following actions:
  - State in the program announcements that NSF may conduct surveys of RET participants and that PIs are therefore expected to be able to provide contact information for all participants.
  - Notify participants—perhaps in the Program brochure suggested above—that they are likely to be asked to participate in a survey about their experiences.
- Relevance to the classroom was very important both to participants' satisfaction and their ability to use what they learned. We recommend that NSF encourage PIs to focus on making the summer experience relevant to participants' K-14 classroom. For example:
  - Match research experiences to subjects that the participants teach in the classroom.
  - Pair teachers who teach at the same grade level.
  - Provide adequate time and support for participants to translate their research experiences to their classrooms.
- Program announcements state that proposals should describe “sustained follow-up” activities, but a number of participants reported little or no follow-up. Given the importance of follow-up to projects' effectiveness, we suggest that NSF look for ways to help ensure that the proposed follow-up (as well as other proposed activities) actually takes place.

- Teachers who participated for more than one summer tended to benefit considerably more than did single-summer participants. We suggest that 2-year projects for individual participants be encouraged.
- Participants who engaged in a variety of activities during their summer projects tended to benefit more than those who engaged in only a few activities. Therefore, consider encouraging PIs to include a variety of activities in the summer projects, one of which must be hands-on research. We also suggest that, given the limited time, poster presentations and other reports should be minimized, as these activities are less strongly related to positive outcomes than other activities.
- The biggest obstacle to transferring RET knowledge to the classroom was funds for materials and equipment. We recommend that NSF work to ensure that participants receive these funds, as specified in the Program announcements.
- Compared to other outcomes and impacts, long-term partnerships are uncommon, and there is little in the Program announcements about how PIs can meet this goal. Some of the above suggestions for making individuals' experiences more powerful also would tend to facilitate partnerships. In addition, NSF should consider encouraging PIs to recruit participants from the same schools/school districts over multiple years.

## **APPENDIX A**

### **SURVEY QUESTIONNAIRE WITH TOPLINE RESULTS**



**NATIONAL SCIENCE FOUNDATION  
DIRECTORATE FOR ENGINEERING  
RESEARCH EXPERIENCES FOR TEACHERS (RET) PROGRAM  
Participant Survey: Topline Results**

**Overview of Your RET Experiences**

1. In what **summers** have you participated in the RET Program?

(PLEASE SELECT ALL THAT APPLY) (n = 300)\*

Summer, 2001.....	21%	Summer 2001 only	11%
Summer, 2002.....	34	Summer 2002 only	19
Summer, 2003.....	66	Summer 2003 only	54
		More than one summer	16

**If you have participated in RET for only one summer, please skip to question 3.**

2. (If you participated in RET for more than one summer:) Did you participate in the same RET project for both/all of these summers, or was each summer spent in a different RET project?

(PLEASE SELECT ALL THAT APPLY) (n = 47)

My 2001 and 2002 summers were in the same RET project.....	9%
My 2002 and 2003 summers were in the same RET project.....	23
My 2001, 2002, and 2003 summers were in the same RET project.....	19
I spent both/all summers in different RET projects.....	49

3. At which of the following types of organizations did your summer RET experiences take place?

(PLEASE SELECT ALL THAT APPLY FOR EACH APPLICABLE YEAR)

	<i>n</i>	2-Year College College	4-Year College or University	Hospital or Medical Research Facility	Non-Profit Research Organization	U.S. Govern- ment Lab	For-profit Company	Other Type of Organization
a. Summer, 2001	62	0%	90%	13%	3%	5%	2%	5%
b. Summer, 2002	100	1	84	10	1	6	6	1
c. Summer, 2003	195	2	83	4	1	3	12	2
OVERALL	295	1	87	7	2	4	9	4

\* n = number of respondents

## Prior to Your RET Experience

4. **Before the first summer** of your RET experiences, did you do any of the following?  
(PLEASE SELECT ONE IN EACH ROW)

Before the first summer, did you...	<i>n</i>	Yes	No	Don't Remember
a. Receive materials describing the RET work you would be doing?	290	67%	28%	5%
b. Meet in-person to discuss the upcoming summer activities with your RET mentor/program manager?	290	61	37	2
c. Talk on the phone or exchange e-mails about the upcoming summer activities with your RET mentor/program manager?	297	89	10	2

5. **At the start** of your first RET summer project, did you attend any kind of in-person individual or group orientation session? (PLEASE SELECT ONE) (**n = 296**)

Yes	No	Don't remember
82%	16%	3%

6. When you started work during your first RET summer, how well informed do you feel you were about each of the following? (PLEASE SELECT ONE IN EACH ROW)

**LISTED IN DESCENDING ORDER OF MEAN RATING**

	<i>n</i>	Mean	Not At All Informed	Somewhat Informed	Pretty Well Informed	Very Well Informed	Don't Remember
Program logistics (locations of activities, parking, meals, administrative issues, etc.)	299	3.50	2%	9%	25%	63%	1%
The scheduled activities for the summer	298	3.38	3	12	28	56	1
The objectives/goals of your RET summer project	299	3.24	4	15	32	48	<1
What you were expected to do/accomplish during the summer	299	3.22	3	16	34	45	1
The overall RET program objectives/goals	300	3.20	3	20	31	45	1

7. How do you think the preparatory information, meetings, or orientation session could be improved, if at all? (PLEASE BE AS SPECIFIC AS POSSIBLE)

**103 respondents made suggestions**

## RET Activities

8. Which of the following did you do as part of any of your **summer RET experiences**?  
(PLEASE SELECT ALL THAT APPLY) (n = 299) LISTED IN DESCENDING ORDER

**As part of my summer RET experiences, I:**

Worked on a plan for applying aspects of what I learned in RET to my classroom teaching.....	79%
Observed research activities performed by researchers/faculty at the host institution.....	79
Prepared/delivered a poster presentation, written report, or oral presentation describing my RET accomplishments to other RET participants, my mentor, etc.....	75
Attended lectures about current topics/techniques in science, technology, engineering, or mathematics (STEM).....	74
Attended demonstrations of the use of scientific equipment or specific scientific procedures.....	74
Worked on developing curricula/lesson plans for my classroom.....	73
Practiced using scientific equipment or specific scientific procedures.....	73
Read academic literature, journal articles, etc.....	70
Assisted faculty/researchers with their research.....	58
Went on research-related field trips (to other labs on- or off-campus, industry research sites, outdoor research sites, etc.).....	55
Did Internet searches on issues related to translating STEM topics to the classroom.....	53
Received formal or informal training in technical writing/presentation skills.....	44
Attended lectures/demonstrations/workshops about strategies for teaching STEM concepts.....	40
Collected and/or analyzed data or information to try to answer a STEM research question.....	40
Worked on a STEM research project for which I had major responsibility.....	32
Did little or nothing that seemed to me to be real research.....	8
Other major summer activities.....	6

Mean number of activities selected (excluding “did little or nothing that seemed to me to be real research”): 9.3 of 16 listed.

9. Were you housed on/near a host institution for your summer RET activities, or did you commute from your home? (PLEASE SELECT ONE FOR EACH APPLICABLE YEAR)

	<i>n</i>	Housed on/near host institution	Commuted	Some of Both
a. Summer, 2001	61	13%	82%	5%
b. Summer, 2002	102	11	79	10
c. Summer, 2003	193	10	88	2
ALL SUMMERS	295	12	83	7

10. For how many weeks did your RET summer activities last?

(PLEASE ENTER YOUR BEST ESTIMATE FOR EACH APPLICABLE YEAR)

	<i>n</i>	Mean	Min.	Max.	1-2 weeks	3-4 weeks	5-6 weeks	7+ weeks
a. Number of weeks in summer, 2001	61	4.97	1	16	23%	28%	26%	23%
b. Number of weeks in summer, 2002	101	5.83	1	16	14	13	42	32
c. Number of weeks in summer, 2003	194	5.79	1	15	9	23	38	29
OVERALL	294	5.82	1	16	10	21	39	30

11. On average, about how many hours per week did you spend on RET activities each summer that you participated in the RET program? (PLEASE ENTER YOUR BEST ESTIMATE FOR EACH APPLICABLE YEAR)

	<i>n</i>	Mean	Min.	Max.	<21 hrs/wk	21-39 hrs/wk	40 hrs/wk	>40 hrs/wk
a. Hours/week in summer, 2001	62	34	4	56	18%	26%	44%	13%
b. Hours/week in summer, 2002	97	34	3	60	15	31	41	12
c. Hours/week in summer, 2003	191	33	3	60	21	31	37	10
OVERALL	290	34	3	60	18	28	41	12

Total hours spent on RET activities (Q10 \* Q11)

	<i>n</i>	Mean	Min.	Max.
a. Hours in summer, 2001	60	167	8	450
b. Hours in summer, 2002	97	194	8	560
c. Hours in summer, 2003	189	188	6	600
OVERALL	286	226	10	900

12. **During the academic year following your RET summer(s)**, how much interaction, if any, did you have with your RET mentor or other faculty, grad students, etc. you interacted with as part of your summer RET experiences? Please include e-mails, telephone conversations, in-person meetings, etc. (PLEASE SELECT ONE FOR EACH APPLICABLE YEAR)

	<i>n</i>	Mean	How Much Interaction:				
			None	A little	Some	Quite A Bit	A Great Deal
a. Academic year following 2001 summer	63	3.03	11%	27%	24%	24%	14%
b. Academic year following 2002 summer	98	3.15	10	21	27	27	15
c. Academic year following 2003 summer	194	3.15	9	22	29	27	14
MAX INTERACTION	294	3.09	11	22	28	25	14

### Your Assessments of Your RET Experiences

13. Overall, how did you feel about the amount of each of the following during your **summer RET activities**? (PLEASE SELECT ONE IN EACH ROW)  
LISTED IN DESCENDING ORDER OF “ABOUT THE RIGHT AMOUNT”

	<i>n</i>	Mean	Too Little	About the Right Amount	Too Much
Your summer RET work load overall	297	1.98	5%	93%	2%
The amount of time you spent attending lectures, workshops, demonstrations, and meetings	297	1.99	10	80	9
The amount of time you spent on hands-on research activities	297	1.82	21	76	3
The amount of time you spent on curriculum development or translating research experiences to the classroom	300	1.76	26	71	2

14. Considering your own needs, interests, time constraints, etc., how many weeks would you like your RET summer activities to have lasted? (PLEASE ENTER YOUR BEST ESTIMATE FOR EACH APPLICABLE YEAR)

	<i>n</i>	Mean	Min.	Max.	1-2 weeks	3-4 weeks	5-6 weeks	7+ weeks
a. Preferred number of weeks in summer, 2001	62	5.10	1	16	18%	24%	34%	24%
b. Preferred number of weeks in summer, 2002	98	5.71	1	14	11	27	31	32
c. Preferred number of weeks in summer, 2003	188	5.59	1	14	9	34	30	28
OVERALL	288	5.62	1	16	9	30	32	29

15. Overall, how relevant were your RET activities to the subjects you currently teach?

(PLEASE SELECT ONE) (n = 300)

- Not at all relevant ..... 3%
- Somewhat relevant ..... 30
- Very relevant ..... 57
- Doesn't apply: I am not now a teacher ..... 10

16. For each of the following, please indicate: (A) if your RET activities addressed it at all and, if yes, (B) how much RET increased your awareness? (PLEASE SELECT ALL THAT APPLY)

[RESPONSES HAVE BEEN CONVERTED TO A SINGLE SCALE; LISTED IN DESCENDING ORDER OF MEAN RATING]

	How Much Awareness Increased				
	<i>n</i>	Mean	None	Some	A Lot
Current science, technology, engineering, or mathematics (STEM) research issues	289	2.34	12%	43%	45%
New materials/equipment (other than computers) that could be useful to you as a teacher	294	2.13	23	42	35
How to use computers more effectively in your teaching	294	1.89	35	41	23
STEM career options	288	1.79	43	35	22
Magazines/professional journals that could be useful to you as a teacher	295	1.63	52	34	14

17. For each of the following, please indicate (A) if your RET activities addressed it at all and, if yes, (B) how much RET increased your understanding? (PLEASE SELECT ALL THAT APPLY)

[RESPONSES HAVE BEEN CONVERTED TO A SINGLE SCALE; LISTED IN DESCENDING ORDER OF MEAN RATING]

	How Much Understanding Increased				
	<i>n</i>	Mean	None	Some	A Lot
How to conduct a research project	290	2.09	23%	45%	32%
How scientific knowledge is built	289	2.01	27	45	28
STEM applications in everyday life	293	2.03	26	45	29
How to deal with research setbacks, frustration, "negative results," etc.	293	1.91	34	41	25
Ethical dimensions of STEM research	289	1.76	44	36	20

18. To what extent, if at all, do you think your RET experiences increased **your ...**

(PLEASE SELECT ONE IN EACH ROW)

LISTED IN DESCENDING ORDER OF MEAN RATING

	<i>n</i>	Mean	No Increase	Increased Some	Increased A Lot	Have No Idea
...general knowledge base in science, technology, engineering, or mathematics (STEM)	298	2.54	2%	43%	55%	<1%
...motivation to find ways to improve your students' learning	299	2.54	6	34	60	1
...ability to convey the excitement/vitality of STEM to students	295	2.40	9	40	49	2
...confidence in your ability as a STEM teacher generally	297	2.33	11	44	43	2
...professional opportunities	297	2.19	18	45	36	1
...skills in using the Internet to obtain information that will be helpful to your teaching	297	1.89	32	46	21	1

19. How dissatisfied or satisfied were you with each of the following aspects of your RET experience?  
**(PLEASE SELECT ONE IN EACH ROW) LISTED IN DESCENDING ORDER OF MEAN RATING**

	<i>n</i>	Mean	Very <u>Dissatisfied</u>	Somewhat <u>Dissatisfied</u>	Somewhat Satisfied	Very Satisfied	Doesn't Apply
The adequacy of your stipend	301	3.71	1%	3%	19%	76%	1%
The timeliness of your paychecks	301	3.68	4	2	17	76	1
The experience as a whole	299	3.66	1	4	23	72	<1
The helpfulness of the RET staff	299	3.64	3	4	19	73	1
The helpfulness of graduate students and postdocs	299	3.63	2	3	20	65	10
Your relationship with your mentor, overall	299	3.63	4	5	17	74	1
How well organized the summer activities were	298	3.48	4	7	26	62	1
The relevance of your RET experience to the subjects you teach	299	3.46	3	7	30	59	1
Your opportunity to interact and discuss STEM issues with other teachers during the summer program	299	3.41	4	8	27	55	6
Your mentor's knowledge of the roles/responsibilities of K-12 STEM teachers	299	3.35	6	8	31	53	3
Your mentor's interest in helping you develop a plan to transfer what you learned to your classroom	300	3.35	5	9	30	53	3
Your opportunity to interact and discuss STEM issues with faculty/researchers	300	3.34	5	8	31	50	5
The extent to which you felt that you were an integral part of a research team	301	3.15	8	12	35	42	4

20. Are you planning to participate in RET this summer? **(PLEASE SELECT ONE) (n = 299)**

**NOTE: Because the data collection began in the spring and ended in the fall, responses to this question are difficult to interpret.**

Yes, in a continuation of the project I have been in ..... 12% → *Please skip to question 22*  
 Yes, but in a different RET project than I have been in ..... 11  
 No ..... 51  
 Not sure ..... 26

21. If it were possible, would you *like* to return to the same RET project this coming summer for a continuation of your previous RET work there? (PLEASE SELECT ONE) (n = 300)  
**NOTE: Because the data collection began in the spring and ended in the fall, responses to this question are difficult to interpret.**

- No, definitely not ..... 5%
- No, probably not ..... 26
- Yes, probably ..... 28
- Yes, definitely ..... 35
- Have no idea ..... 6

**RET Outcomes and Impacts**

22. What was your occupation immediately before you first participated in RET? (PLEASE SELECT ALL THAT APPLY) (n = 300)

- Teacher/Faculty member ..... 98%
- School administrator..... 1
- Curriculum specialist..... 3
- Student..... 2
- Other..... 1

23. Have you changed jobs since you first participated in RET? (PLEASE SELECT ONE) (n = 301)

- Yes..... 16% → Please answer Q24
- No ..... 84 → Please skip to next page [Q25/Q41]

**PROGRAMMING NOTE:**

**IF Q22=1 AND Q23=2, SKIP TO Q25 = if R was a teacher and did not change jobs, skip to Q25**  
**IF Q22 NE 1 AND Q23=2, SKIP TO Q41 = if R was not a teacher and did not change jobs, skip to Q41**

24. What is your current occupation? (PLEASE SELECT ALL THAT APPLY) (n = 298)  
 (Note: percentages are based on all respondents)

- Teacher/Faculty member ..... 92%
- School administrator..... 3
- Curriculum specialist..... 3
- Student..... 2
- Retired ..... 1
- Other..... 3

**PROGRAMMING NOTE:**

**IF Q24=1 AND Q22 NE 1, SKIP TO Q29 = if R is now a teacher and was not a teacher pre-RET, skip to Q29**  
**IF Q24 NE 1 & Q23=1, SKIP TO Q40 = if R is not now a teacher and changed jobs since RET, skip to Q40**

**[QUESTIONS 25-28 WERE ASKED ONLY OF THOSE WHO WERE TEACHERS BEFORE RET AND STILL ARE TEACHERS]**

25. For each of the following, please indicate (A) if you have done this since participating in RET and, if yes, (B) whether your post-RET use is less, the same amount, or more than your pre-RET use?

(PLEASE SELECT ALL THAT APPLY)

**[RESPONSES HAVE BEEN CONVERTED TO A SINGLE SCALE; LISTED IN DESCENDING ORDER OF “HAVE DONE THIS MORE SINCE RET”]**

	<i>n</i>	Have Done This Since RET	Have Done This <u>More</u> Since RET
Talked with or counseled students about careers in science, technology, engineering, or mathematics (STEM) fields	249	92%	58%
Encouraged students to access the Internet to learn more about STEM topics	248	74	39
Read scientific/engineering journal articles	248	75	31
Became involved in STEM-related extracurricular activities (for example, school science club)	247	57	28

26. For each of the following instructional strategies for STEM subjects, please indicate:  
(A) If your participation in RET has affected how much you use this strategy and, if yes,  
(B) Whether your post-RET use is less or more than your pre-RET use?

(PLEASE SELECT ALL THAT APPLY)

**[RESPONSES HAVE BEEN CONVERTED TO A SINGLE SCALE; LISTED IN DESCENDING ORDER OF MEAN RATING]**

	<i>n</i>	Mean	Less Now	No Effect	More Now
Assign projects based on “real world” problems	245	2.81	<1%	18%	81%
Tell students about or use new technologies	240	2.80	1	19	80
Integrate math, science, and technology	247	2.77	0	23	77
Use hands-on activities in your classroom	248	2.72	<1	27	72
Assign joint or group projects	246	2.64	1	33	65
Use computers	246	2.63	1	35	64
Require oral presentations or written reports	245	2.61	1	36	62
Take students on field trips to research labs/facilities	244	2.28	4	65	32

Other RET-influenced instructional strategies you have used:

**30 respondents provided a response**

27. In which of the following ways, if any, have any of your students been affected by changes in your teaching following your RET experiences? (PLEASE SELECT ALL THAT APPLY) (n = 245)

Doesn't apply to me: RET did not change my teaching ..... 12%

**LISTED IN DESCENDING ORDER:**

They have become more aware of STEM careers options ..... 56%  
 They have more positive attitudes about STEM subjects in general ..... 53  
 They are more interested in my classes ..... 52  
 They have become more interested in STEM careers ..... 44  
 They are less intimidated by STEM subjects ..... 39  
 They are doing a better job of learning STEM subjects ..... 36  
 They have started/joined a STEM club ..... 14  
 They have participated in research at my RET institution ..... 12  
 None of the above ..... 5  
 Other RET effects on my students ..... 5

28. (If your students have been affected in any of the above ways:) If there have been any **other major influences** at your school, besides RET, that have contributed to your students' changed attitudes about STEM, please describe them briefly: **(42 individuals provided a response; percentages are based on the 204 respondents to whom the question was applicable)**

**Responses have been categorized as follows:**

Other intervention programs	5%
New curriculum or courses	4
Competitions	3
More computers, technology	2
STEM clubs	1
Other	4

**[QUESTIONS 29-39 WERE ASKED ONLY OF THOSE WHO ARE CURRENTLY TEACHERS]**

29. Which of the following have happened since you began your RET experiences?

(PLEASE SELECT ALL THAT APPLY) (n = 262) LISTED IN DESCENDING ORDER

I included examples or applications from my RET activities in my teaching .....	81%
I acquired new skills in RET that I was able to use in my classroom .....	65
I have implemented in my classroom curricula/lesson plans that I developed as part of my RET activities .....	61
I have shared RET-derived information, materials, or other resources with other teachers in my school/district .....	53
I received materials, supplies, or equipment from my RET institution that I have been able to use in my classroom .....	48
I used contacts or experiences from RET to obtain new resources for my classroom .....	39
As a result of my RET experiences, I began teaching additional/different subjects than I did before my RET experiences .....	37
During the academic year(s), I have networked with other RET teachers about teaching or other professional issues .....	28
Faculty/researcher(s) from my RET institution came to my school to meet with my students (gave presentations, counseled about careers, etc.) .....	26
As a result of my RET experiences, I assumed new leadership roles or responsibilities in my school/district/region .....	18
I took students to my RET college/university .....	17
I have organized/facilitated in-service workshops for other teachers/school personnel on issues related to my RET experiences.....	16
As a result of my RET experiences, I changed jobs .....	1
None of the above.....	5

30. Before you began your participation in RET, had your school/district and a college/university developed a partnership to improve K-12 STEM education? (PLEASE SELECT ONE) (n = 263)

Yes.....	22%	→ Please skip to question 32
No .....	46	
Not sure .....	32	

31. Have your school/district and a college/university developed a partnership to improve K-12 STEM education as a result of your RET experiences? (PLEASE SELECT ONE) (n = 256; responses incorporated with Q30 responses)

Developed before RET .....	22%
Yes, developed as a result of RET.....	11
Not yet, but it is likely to happen in the future .....	20
Not yet, and as far as I know there are no plans for it....	47

**[QUESTIONS 29-39 WERE ASKED ONLY OF THOSE WHO ARE CURRENTLY TEACHERS]**

32. How much of an obstacle, if any, has each of the following been to your ability to transfer what you learned in RET to your classroom(s)? (PLEASE SELECT ONE IN EACH ROW)

**LISTED IN DESCENDING ORDER OF MEAN RATING**

	<i>n</i>	Mean	Not an Obstacle	A Minor Obstacle	A Major Obstacle	Have No Idea
Materials, equipment, etc. are too expensive	258	2.22	22%	31%	43%	3%
Not enough time on your part to prepare new lesson/lab plans, etc.	258	1.91	33	41	24	2
The level of the science is too high	262	1.78	41	37	19	3
Materials, equipment, etc. that you are planning to use are not yet available	257	1.73	44	27	20	9
The scientific topics are too different	260	1.72	42	40	15	3
The school's curriculum is inflexible	258	1.67	51	28	19	3
School has poor/no access to computers/Internet	260	1.57	58	25	15	2
School administrators are resistant to your proposed changes	256	1.30	70	17	5	7
Other teachers resent or don't support your proposed changes	254	1.28	72	16	5	7

3% of respondents (9 individuals) specified other obstacles

33. As far as you know, approximately what percentage of your students has access to the Internet **at home**? (PLEASE SELECT YOUR BEST ESTIMATE) (n = 264)

Fewer than 25% .....	15%
25% to 49% .....	18
50% to 74% .....	25
75% or more .....	38
Have no idea.....	5

**[QUESTIONS 29-39 WERE ASKED ONLY OF THOSE WHO ARE CURRENTLY TEACHERS]**

34. What subject(s) do you teach? (PLEASE SELECT ALL THAT APPLY) (n = 264)  
**LISTED IN DESCENDING ORDER**

Physics	34%	General/integrated science	7%
Biology	30	Computer science	5
Mathematics	27	Elementary ed	3
Chemistry	25	Life sciences	2
Technology education	18	Robotics	2
Engineering	11	Other	10
Physical/earth sciences	9		

35. Which of the following best describes the level of the school at which you work?  
 (PLEASE SELECT ONE) (n = 264)

Elementary.....	7%	
Junior high/middle school .....	26	
High school.....	63	
Two- or four-year college.....	2	→ Please skip to question 40
Other.....	2	

36. By which of the following types of schools are you currently employed?  
 (PLEASE SELECT ONE) (n = 259)

Public district school ( <u>not</u> a magnet school).....	80%
Public magnet school.....	14
Private school .....	5
Other.....	1

37. Which of the following best describes your school's location? (PLEASE SELECT ONE) (n = 257)

Urban .....	48%
Suburban.....	35
Rural .....	17

38. Approximately what percentage of the student body of your school is eligible for a free or reduced price lunch? (PLEASE SELECT YOUR BEST ESTIMATE) (n = 259)

Fewer than 25% .....	26%
25% to 49% .....	28
50% to 74% .....	17
75% or more .....	22
Have no idea.....	7

**[QUESTIONS 29-39 WERE ASKED ONLY OF THOSE WHO ARE CURRENTLY TEACHERS]**

39. Which of the following types of students do you teach? (PLEASE SELECT ALL THAT APPLY) (n = 258)

General .....	84%
Advanced.....	66
Remedial.....	33
English as a second language (ESL).....	28
Learning disabled (LD) .....	32

**Background Information**

40. As of now, for how many years have you been (or were you) a teacher?  
(PLEASE ENTER YOUR BEST ESTIMATE) (n = 283)

1 to 5 years	24%
6 to 10 years	27
11 to 15 years	17
16 to 20 years	14
More than 20 years	19

<u>Mean</u>	<u>Min.</u>	<u>Max.</u>
13.0	1	40

41. Since you began your participation in RET, have you enrolled in any teacher education or STEM courses, certificate programs, certification programs, or degree programs?  
(PLEASE SELECT ALL THAT APPLY IN EACH COLUMN) (n = 263)

	<u>Teacher Education</u>	<u>STEM</u>
Course	25%	8%
Certificate program	8	1
Certification program	7	1
Degree program	16	4
None of the above	58	87

42. What is the highest level of education that you have completed? (PLEASE SELECT ONE) (n = 296)

Bachelor's degree .....	12%
Graduate work but no advanced degree .....	21
Masters .....	33
Post-Masters work but no doctorate .....	26
EdD.....	1
PhD.....	5
Other .....	2

43. Please indicate below the field(s) in which you have received your degree(s), as applicable.  
 [This was an open-ended question; responses were coded into the categories listed below.]

**LISTED IN DESCENDING ORDER FOR EACH TYPE OF DEGREE**

**A. Undergraduate major(s): (n = 282)**

Life sciences	24%
STEM education	15
Education (general)	15
Physical/earth sciences	12
Social sciences	11
Math	10
Engineering/technology	10
Chemistry	7
Science (general)	3
Other	12

**B. Master's: (n = 187)**

Education (general)	52%
STEM education	20
Engineering/technology	8
Life sciences	7
Physical/earth sciences	6
Social sciences	3
Chemistry	2
Math	2
Science (general)	1
Other	6

**C. PhD: (n = 20)**

Education (general)	25%
Physical/earth sciences	20
Engineering/technology	20
Chemistry	15
Life sciences	10
STEM education	5
Social sciences	5

**D. Other graduate work: (n = 79)**

Education (general)	44%
Life sciences	18
Physical/earth sciences	14
STEM education	13
Engineering/technology	9
Science (general)	5
Math	5
Chemistry	1
Social sciences	1
Other	3

44. What is your age? (PLEASE SELECT ONE) (n = 291)

Under 30 .....	12%
30 to 39 .....	31
40 to 49 .....	28
50 to 59 .....	25
60 to 69 .....	4
70 or older.....	0

45. What is your gender? (PLEASE SELECT ONE) (n = 290)

Male .....	54%
Female.....	46

46. What is your race/ethnicity? (PLEASE SELECT ALL THAT APPLY) (n = 290)

American Indian or Alaskan Native.....	2%
Asian .....	4
Black or African American .....	16
Hispanic or Latino.....	6
Native Hawaiian or Pacific Islander .....	<1
White.....	78
Other .....	0

47. What do you think was the single most important outcome of your participation in the RET program?  
**259 individuals responded**

48. What do you think was the most important impact, if any, that your participation in the RET program had on your students or your school/school system?  
**244 individuals responded**

49. If you have any suggestions for improving the RET program as a whole, please provide them here.  
**111 individuals provided a suggestion**

50. Other comments.  
**82 individuals commented**

**Thank you very much for your participation in this study.**



## **APPENDIX B**

### **SURVEY ITEMS COMPRISING EACH INDEX**



## **SURVEY ITEMS COMPRISING EACH INDEX**

### **Outcomes**

#### **New Teaching Strategies**

- Q26B1 RET effect: use more hands-on activities in classroom
- Q26B2 RET effect: more projects based on real world problems
- Q26B3 RET effect: more joint or group projects
- Q26B4 RET effect: require more oral/written reports
- Q26B5 RET effect: more integrate math/science/technology
- Q29\_1 Included examples from RET in teaching
- Q29\_2 Acquired new skills for classroom
- Q29\_3 Implemented lessons developed at RET

#### **Increased Teaching Capabilities**

- Q16B3 Awareness: new materials useful to teacher
- Q17B4 Understanding: STEM applications in life
- Q18A Increased general knowledge base in STEM
- Q18C Increased ability to convey STEM excitement
- Q18D Increased confidence as STEM teacher
- Q18F Increased motivation to improve students' learning

#### **Computers/Technology**

- Q16B2 Awareness: use computers more effectively
- Q18B Increased skills in using the Internet
- Q25B2 RET effect: encouraged student access to Internet
- Q26B6 RET effect: use computers more
- Q26B7 RET effect: use new technologies more

#### **Research Knowledge**

- Q16B4 Awareness: current STEM research issues
- Q17B1 Understanding: how to conduct a research project
- Q17B2 Understanding: how to deal with research setbacks
- Q17B3 Understanding: how scientific knowledge is built
- Q17B5 Understanding: ethical dimensions of STEM research

#### **STEM Career Awareness**

- Q16B5 Awareness: STEM career options
- Q25B1 RET effect: talked w/students about STEM careers

#### **New Materials**

- Q29\_7 Received materials from RET inst
- Q29\_9 Used contacts to obtain new resources

**STEM Publication Awareness**

- Q16B1 Awareness: magazines/professional journals
- Q25B3 RET effect: read scientific journal articles

**New Activities/Opportunities**

- Q18E Increased professional opportunities
- Q25B4 RET effect: involved in STEM extra activities
- Q29\_12 Assumed new leadership roles
- Q29\_13 I changed jobs
- Q29\_5 Began teaching new subjects

**Networking and Sharing**

- Q29\_10 Organized workshops for other teachers
- Q29\_11 Networked with other RET teachers
- Q29\_8 Shared RET-derived info w/teachers
- Q31 As result of RET, developed partnership

**Research-Related Visits**

- Q26B8 RET effect: more field trips to research labs
- Q29\_4 Faculty from RET came to school
- Q29\_6 Took students to my RET college

**Student effects: question 27**

- Q27\_1 Doesn't apply to me: RET did not change my teaching
- Q27\_2 They are more interested in my classes
- Q27\_3 They have more positive attitudes about STEM subjects in general
- Q27\_4 They are less intimidated by STEM subjects
- Q27\_5 They are doing a better job of learning STEM subjects
- Q27\_6 They have become more aware of STEM careers options
- Q27\_7 They have become more interested in STEM careers
- Q27\_8 They have started/joined a STEM club
- Q27\_9 They have participated in research at my RET institution
- Q27\_10 None of the above
- Q27\_11 Other RET effects on my students

## **Satisfaction**

### **The RET experience**

- Q19A Satisfied: relevance to subjects you teach
- Q19C Satisfied: helpfulness of grad students
- Q19D Satisfied: mentor's knowledge of K-12 teachers
- Q19E Satisfied: mentor's help to transfer to classroom
- Q19F Satisfied: relationship with your mentor
- Q19G Satisfied: op interact w/ faculty
- Q19H Satisfied: op interact w/ other teachers
- Q19I Satisfied: an integral part of research team
- Q19M Satisfied: the RET experience as a whole

### **Administrative issues**

- Q19B Satisfied: helpfulness of RET staff
- Q19J Satisfied: adequacy of your stipend
- Q19K Satisfied: timeliness of your paychecks
- Q19L Satisfied: how well organized

### **Obstacles: question 32a-i**

- Q32a The scientific topics are too different
- Q32b The level of the science is too high
- Q32c The school's curriculum is inflexible
- Q32d School has poor/no access to computers/Internet
- Q32e Materials, equipment, etc. are too expensive
- Q32f Materials, equipment, etc. that you are planning to use are not yet available
- Q32g Not enough time on your part to prepare new lesson/lab plans, etc.
- Q32h School administrators are resistant to your proposed changes
- Q32i Other teachers resent or don't support your proposed changes