AC 2008-2825: RESEARCH EXPERIENCE FOR UNDERGRADUATES IN NANOTECHNOLOGY: ANALYSIS OF PARTICIPANTS 1997-2007

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Research Experience for Undergraduates in Nanotechnology: Analysis of Participants 1997-2007

Abstract

Nanotechnology is considered by many to be the next "industrial revolution." The National Science Foundation (NSF) estimates that by 2015 nanoscale science and engineering will be $1.5 – 2.0 trillion industry with the U.S. needing approximately 1 million workers. Workforce development programs are needed to excite undergraduates about possible education and career opportunities to ensure that the U.S. maintains its competitive edge in this fast-growing field. The National Nanotechnology Infrastructure Network (NNIN) is an integrated geographically-diverse partnership of 13 university-based laboratories supported by the NSF. The NNIN also has extensive education outreach programs for the K-gray population. One such program is our NNIN Research Experience for Undergraduates (REU). NNIN has a strong commitment to the broader mission of nanotechnology education, knowledge transfer, and outreach for the nation. Since 1997, NNIN (and its predecessor NNUN) has conducted a network wide, multi-site REU program. Between 40 and 80 students participate annually in the NNIN REU and over 500 undergraduates having completed this summer research program. We have several years' worth of evaluation results from annual surveys which we use to modify the program and to measure the impact of our program on career choices. The later objective is challenging because it plays out over the course of 10 years after the REU experience. Because of its size and long history, the NNUN/NNUN program has had the opportunity to generate statistically meaningful, long-term outcome data on its participants. We have a continuing investigation of the career paths and educational impact of our program on the approximately 250 participants in the first seven years of the program (1997-2003). To date, we have contacted ~100 of the 250 participants. Seventy percent of the respondents indicated that the program significantly or very significantly influenced their career path. We are continuing this time-intensive longitudinal study in locating past participants by means of mailings, internet searches, and links on our website. However, we believe that such efforts will provide information specifically on the impact of our program and REU programs in general.

Introduction

The National Nanotechnology Infrastructure Network (NNIN) is a National Science Foundation (NSF) funded program which supports nanoscience researchers by providing state-of-the-art nanotechnology facilities, support, and resources. The NNIN is a consortium of thirteen universities (12 member sites and one affiliated site) across the United States (http://www.nnin.org). NNIN's mission is to support nanotechnology research and development needs of academic, industrial, and governmental users by providing tools, training, and process knowledge. In addition to researcher support, the NNIN has a large and integrated education and outreach program. The focus of the program is to develop a workforce ready for the demands of the rapidly developing field of nanotechnology as well as develop a nano-literate public. Our Research Experience for Undergraduates (REU) program is one part of the education mission to excite and

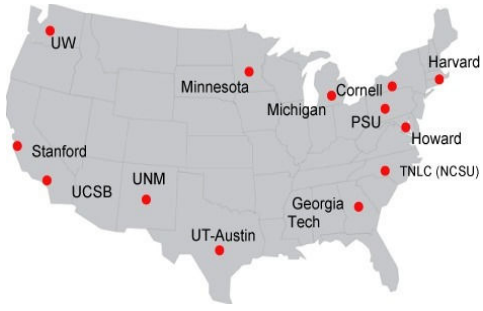

Figure 1 Distribution of NNIN sites

encourage undergraduates to pursue education and careers opportunities in nanoscale science and engineering.

Nanotechnology, which studies and uses the unique phenomena that occur at the nanoscale, is a rapidly advancing area of research. It is an exciting interdisciplinary area which crosses the disciplines of science and engineering. Nanotechnology is viewed by many as the next great technical revolution. Evidence for this belief is in the establishment of the National Nanotechnology Initiative (NNI) and the more than tripling of its budget since its inception in 2001 from $464 million to approximately $1.5 billion in 2008. A substantial portion of the funding increase to several federal agencies has been due to the *American Competitiveness Initiative* authorized by the U.S. Congress. The NNIN REU program addresses three of the goals of the NNI[1]:

- Maintain a world-class research and development program aimed at realizing the full potential of nanotechnology
- Develop educational resources, skilled workforce, and the supporting infrastructure and tools to advance nanotechnology; and,
- Support responsible development of nanotechnology

In addition, the REU program addresses one goal of the *American Competitiveness Initiative*[2]

- 10,000 more scientists, students, post-doctoral fellows, and technicians will have opportunities to contribute to the innovation enterprise.

The NSF estimates that by the year 2015 there will be a need for two million workers worldwide in the fields of nanoscience and nanotechnology.[3] An additional 5 million workers will be needed in support areas. Of these two million workers, it is estimated that the workforce needs will be 0.8-0.9 million for the U.S., 0.5-0.6 million for Japan, and 0.3-0.4 million for the E.U. The need for a skilled workforce to meet this challenge has been highlighted in two recent reports: *Innovate America*[4] and *Engineering Research and America's Future: Meeting the Challenges of a Global Economy*[5] which stress the critical importance of technological innovation in U.S. competitiveness, productivity, and economic growth. Nanotechnology is seen as one of these technologically important fields and as noted in *Innovate America,* "nanotechnology could impact the production of virtually every human-made object." The NNI continues to recognize the importance of education through increased allocations to the NSF budget. NSF's budget for education, ethical, legal, and social issues has increased from $29.1 million in 2005 to $33.4 million in 2007.[6]

The economic importance of nanoscience and nanotechnology has not yet been fully realized. However, it is rapidly expanding with more than 40 countries having national activities in nanoscale science and engineering. To meet the need of an educated populace that can work in nanotechnology as well as support its safe development, it is critical that universities/colleges, governments, and industries support nano-education efforts. The NNIN REU program has been in operation since 1997 and has been designed to support the continuous development of a technically capable U.S. workforce.

NNIN REU Program

The NNIN's primary program for undergraduates is its REU. The NNIN has developed, operated, and managed a highly successful REU Program in Nanotechnology for over ten years. This program began under the National Nanotechnology Users Network (NNUN) which

consisted of five of the current NNIN sites: Cornell University, Howard University, Pennsylvania State University, Stanford University, and University of California Santa Barbara. In 2004, with the awarding of the NNIN, the REU program grew to include seven additional sites: Georgia Institute of Technology, Harvard University, University of Michigan, University of Minnesota, University of New Mexico, University of Texas (Austin), and University of Washington. The objectives of the NNIN REU program are:

- Provide advanced nanotechnology research project experience, and training on advanced equipment;
- Promote student excitement towards graduate-level research and careers in nanoscale science
- Recruit and provide opportunities for women, minorities, and students from non-research institutions
- Enhance student presentation skills and expose them to a breadth of nanotechnology research topics.

We have developed feedback and survey instruments for current and former students to determine if we are reaching our program objectives. In addition, each year we have an external evaluation performed during our end-of year Convocation. The Convocation occurs annually at one site with all interns presenting their research results in oral and poster format. During this three-day event, the external evaluator interviews the interns to determine program strengths and weaknesses.

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The NNIN REU program consists of a ten-week summer research program which now supports approximately 70 students across the network. The focus of the program is to stimulate and excite undergraduate students with advanced research projects involving the nanoscale across many disciplines by leveraging advanced facilities, outstanding faculty, and strong mentoring and training. Because NNIN is focused on user training and development, we are able to rapidly and efficiently train students so that they learn the tools and processes necessary for their research projects. Participants work with faculty advisors and graduate student mentors to conduct an independent research project. A goal of the program is to have participants move towards being independent researchers who are capable of clearly articulating his/her results.

From our years of experience, we have determined what works well in running a multi-site REU program. It is a vast task to process approximately 400-500 applications per year, match students to locations and projects, and maintain a sense of a networked program across 12 individual sites. Through annual surveys, annual evaluations, and discussions, we have evolved into a combination of local and national program components that successfully address participants' needs.

The national coordination of the program is run by Cornell University with support from an advisory committee consisting of staff from Georgia Tech, Stanford, and UC Santa Barbara. NNIN provides a common, electronic version of the application. Notice of the application process is sent to over 4,000 science and engineering programs across the country. The application can be viewed at our web site: http://www.nnin.org/nnin_reu.html. We have learned that it is important to have an early deadline (late February) and to process the applications quickly as students begin to make decisions about summer opportunities well before the end of the semester. Below is a timetable of the process we have developed over several years of

operation and have found to be successful in recruiting students as well as providing a smooth transition into the research experience for our interns.

Table 1. NNIN REU Timetable

Date	NNIN REU activity
October	Review prior evaluations site by site and program-wide. Make necessary corrections.
Dec/Jan	Review site expectations/timetable with REU site coordinators & site directors. (Cornell leads)
February	Application deadline (~21st). Site training of faculty & mentors.
March	Applications sorted at Cornell & sent to sites. Faculty & mentors review applications & make selections – list forwarded to Cornell. Offer process begins. Project description & faculty/mentor contact info mailed to intern selections by site.
April	Selection process completed. Housing and travel arranged by site. Faculty & mentors begin discussions w/ interns -- recommend readings and online training.
May	Sites send interns program guidelines/schedule/expectations & online link to orientation and training. Sites review projects with faculty & mentors, ensures availability of equipment & supplies, reviews research plan & training requirements. Reviews mentor and NNIN REU program expectations.
June	Interns arrive and undergo facility, campus, and research orientation,

Cornell coordinates all of these activities by sending reminders to each site's REU coordinators who are responsible for implementing the NNIN REU requirements and expectations. The NNIN REU expectations are sent to each site to be sahred with all faculty and mentors who work with the interns.

At the local level, each NNIN site is required to recruit faculty advisors and postdoctoral/graduate student mentors along with hands-on research projects that use the facilities and resources of that site. The selection recommendations occur at the site with faculty and mentors choosing students that they believe are best suited for their projects. Each site provides mentor training using NNIN-developed materials. The goal is to allow the mentors to understand how to move the interns from dependent to independent researchers, i.e., to know when to and when not to provide intern support. To ensure that interns arrive with an understanding of the research project, site coordinators request that faculty and mentors provide pertinent reading material and develop an online conversation prior to the interns' arrival at the site. Because NNIN is a user training network, we also have numerous equipment training videos which interns are directed to review (videos pertaining to their research projects) prior to arrival. As with our research users, we have found that this allows the interns to have quick and smooth training on equipment and processes once they arrive at the facilities.

As noted in our program objectives above, we seek to provide opportunities for individuals underrepresented in Science, Technology, Engineering, and Mathematics (STEM) education and

careers. Numerous studies have indicated the need to increase undergraduate and graduate enrollment in STEM to maintain the U.S. competitive edge and world dominance in science and technology[4,5,7]. These reports also note that more needs to be done to recruit underrepresented minorities into STEM education and careers. The recent release of the National Science Board's *Science and Engineering Indicators 2008*[8] provides some insight into how well we are doing in terms of undergraduate and graduate degrees in STEM (1985 to 2005). The report notes that there has been an increase in bachelor's and master's degrees in science and engineering and that the proportion of degrees awarded to white students has declined from 82% to 65%. Women account for more than half of these undergraduate degrees but there are differences between fields. Women earned the following percentages of bachelor's degrees in STEM fields: 78% in psychology, 51% agricultural sciences, 62% biological sciences, 52% chemistry, 54% social sciences, 20% engineering, 22% computer sciences, and 21% physics.

Undergraduate degrees by minorities are also detailed in the NSB report. The NSB report indicates race/ethnicity as white/non-Hispanic, Black, non-Hispanic, Hispanic, Asian, and other (native Hawaiians, Pacific Islanders, American Indians, and Alaska Natives)Underrepresented students earn a higher proportion of associate's degrees in comparison to earning bachelor's and advanced degrees. The proportion of bachelor's degrees awarded to black students rose from 5% to 8%, to Hispanic students from 4% to 8% and to American Indian/Alaska Native from 0.4% to 0.7%. While there are increases in the number of STEM degrees awarded to minority groups the attainment gap between whites and these groups is still very wide. One interesting result of the NSB analysis is the proportion of science and engineering degrees by racial/ethnic group: one-third of bachelor's degrees in every racial/ethnic group are in science and engineering. We use these indicators to emphasize with our sites to actively recruit students from associate-degree granting institutions and minority serving institutions.

Results from the NNIN REU Program

The NNIN REU program draws participants from a diverse applicant pool, which includes a moderate number of applications from women, minorities, and students from non-research (non Ph.D-granting) institutions. Because of widespread advertising and a long history as an REU program we can select participants from a large applicant pool. Since the program began in 1997, we have been committed to providing research opportunities to students who have the most to gain from the NNIN REU experience -- 67% of the 2005, 53% of the 2006, and 74% of the 2007 interns had not participated in a prior summer research experience. Below is the demographic make-up of applicants and participants and their type of home institution for 2005 through 2007.

Table 2. NNIN REU demographics of applicants and participants 2005-2007.

	Applicants			**Applicant Pool (%)**			**Participants**			**Application Success Rate**			**Participation (%)**		
	'05	**'06**	**'07**	**'05**	**'06**	**'07**	**'05**	**'06**	**'07**	**'05**	**'06**	**'07**	**'05**	**'06**	**'07**
Overall	500	354	403				81	64	70	16%	18%				
Gender															
Women	148	97	134	30%	27%	33%	33	28	24	22%	29%	18%	41%	44%	34%
Men	352	257	269	70%	73%	77%	48	36	46	14%	14%	17%	59%	56%	66%
Race/Ethnicity*															

Minorities	74	68	57	15%	19%	14%	19	15	21	26%	22%	37%	23%	23%	33%
Non-Minorities	426	259	346	85%	73%	86%	62	45	43	15%	17%	12%	77%	77%	67%
Institution Type															
Ph.D. Level	343	231	258	69%	65%	64%	49	39	43	14%	17%	17%	60%	61%	61%
Master's Level	82	71	72	16%	20%	18%	28	12	13	21%	17%	18%	21%	19%	19%
Bacc. Level	63	40	60	13%	12%	15%	13	11	11	21%	28%	18%	16%	17%	16%
Assoc. Level	12	12	13	2%	3%	3%	1	2	3	8%	17%	23%	2%	3%	4%

* Race/Ethnicity is only for students who reported this information; Minorities include African Americans, Hispanics, Native Americans, Hawaiian/Pacific Islanders, & Alaska Natives.

These results indicate that women and minorities are well represented in the applicant pool but more importantly at a higher participation rate. While the number of participants from two-year colleges and from underrepresented groups is not as high as we would like, we have had success in placing these students into our program at equal to or above the application rate. To continue our recruitment of underrepresented students into the NNIN REU we have developed the *NNN Showcase for Students* which is a one day workshop offered to attendees (primarily undergraduates) at national and regional minority science and engineering associations' conferences. Our first *Showcase* was this fall at the annual meeting of the *Society for Hispanic Professional Engineers* so it is too early in the application process to determine if the number of Hispanic applicants increased or if they heard about the program through the Showcase.

All participants complete an annual evaluation of the program and have consistently rated the program very highly. The surveys are posted on the internet (Survey Monkey) for easy access as well as collection and analysis of results. Below are some of the 2007 post survey results on a Likert scale from 1-5 (5 the highest). The Likert response choices are: 1- Poor/No; 2 – Somewhat/OK; 3 - Good; 4 – Excellent/Yes; 5 – Superior/Very Yes. These results presented here are related to the technical aspects of the program. Participants are also asked questions concerning site support and logistics, mechanics of the program, and information on how they heard about the program and how many programs they applied to. Similar results have been obtained over past years.

Table 3. NNIN REU Post-survey results 2007 (program technical aspects)

Question	**1***	**2**	**3**	**4**	**5**	**Avg.**[1]
Did the program offer you a substantial independent research project with a strong intellectual focus?	0.0%	1.5%	25.8%	30.3%	42.4%	4.14
Were you able to execute the research project using the available equipment and facilities?	0.0%	1.5%	15.4%	40.0%	43.1%	4.25
Did you consider your project a "good" project- interesting, right scale, right complexity, etc.	3.1%	3.1%	15.4%	33.8%	44.6%	4.14
Were you reasonably able to complete	1.5%	4.6%	15.4%	43.1%	35.4%	4.06

the project?						
Were you satisfied with how much you were able to complete, given the time constraints?	1.5%	16.9%	13.8%	29.2%	38.5%	3.86
Did you receive significant scientific interaction with the faculty member/ senior staff in charge of your project?	7.7%	16.9%	13.8%	21.5%	40.0%	3.69
Were you included in group meetings and seminars?	0.0%	6.2%	18.5%	16.9%	56.9%	4.27
Did the program provide you with experience that allowed you to see the breadth of nanotechnology applications?	0.0%	3.1%	18.5%	32.3%	46.2%	4.22
How well did the program assist you in learning to use advanced equipment and processes in nanotechnology?	0.0%	9.2%	12.3%	30.8%	46.2%	4.16
How well did the program assist you in understanding the scientific basis of nanotechnology equipment & processes?	1.5%	3.1%	16.9%	47.7%	30.8%	4.03
How well did the program provide you with an understanding of the graduate research life?	0.0%	3.1%	9.2%	21.5%	66.2%	4.51
How well did the program provide you with an understanding of careers in nanotechnology?	0.0%	0.0%	27.7%	35.4%	35.4%	4.08
Did the program assist you in making future educational & career choices?	0.0%	3.1%	15.6%	23.4%	57.8%	4.36
How likely is it that you will choose a career in nanotechnology?	3.1%	12.3%	16.9%	33.8%	29.2%	3.77
How likely is it that you will go to graduate school in science/engineering?	3.1%	1.6%	9.4%	15.6%	70.3%	4.48
Did the program assist you in developing presentation and writing skills?	0.0%	1.5%	18.5%	33.8%	46.2%	4.25
Was the Convocation a worthwhile experience?	1.5%	1.5%	9.2%	29.2%	58.5%	4.42
Would you recommend the program to a friend?	0.0%	1.5%	7.7%	13.8%	76.9%	4.66
How likely is it that when you return to your home campus that you will share your experiences with fellow students and faculty?	0.0%	3.1%	6.2%	15.3%	75.4%	4.63
How do you rate the overall quality of the program?	0.0%	1.5%	7.7%	26.2%	64.6%	4.54
Did you think that your experience with the program was positive. Would you	1.6%	3.2%	4.8%	14.5%	75.8%	4.60

do it again?						
* Does not include N/A/- Don't know responses as these were minimal (2 questions) [1] Average on a 1-5 Likert Scale with 5 being the highest.						

The 2007 results are typical for past years' programs with fluctuations typically occurring around the ability to complete the research project. Participants are sometimes frustrated if there are equipment problems (typical of any research utilizing technical equipment) which hinder their ability to achieve results. Because we are able to track each respondent's answers to the site that they worked at and the exact research project, we are able to follow-up on an negative comments. If there are consistent negative comments for a site or project director, then the management team steps in to have the issue(s) addressed.

The results presented in Table 3 indicate that the NNIN is meeting its primary objectives:

- Providing advanced research project – 4.14
- Learning to use advanced equipment and processes – 4.16
- Exciting participants about graduate school – 4.48
- Providing information on nano careers – 4.08
- Enhancing presentation and writing skills – 4.25
- Exposing participants to the breadth of nano – 4.22

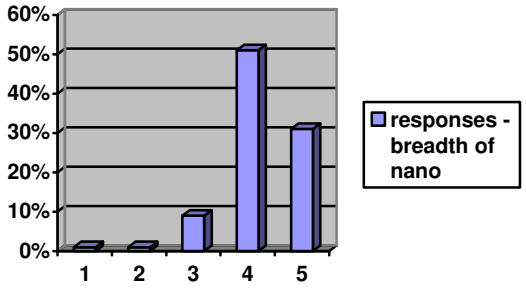
We use the information gained from these post-surveys and external evaluations to make changes to our program. For example, in 2006 many students indicated that the NNIN REU did not provide them with enough information about careers in nanotechnology with this question receiving an average rating of 3.6. In 2007, we began to address this issue by asking sites to provide seminars/workshops on this topic. While the average rating improved to 4.08, it is still an area upon which we need further improvement. Our 2007 results indicated that some interns were not satisfied with the amount of interaction with faculty and/or senior staff (average rating of 3.69 and additional results indicated number of times the intern met with faculty/staff). We have now revised our NNIN REU expectations highlighting the importance of faculty/staff interactions. In addition, sites that had low scores were notified to choose projects from faculty who can devote time to work with the interns in the summer (i.e., no extensive travel or absences during the experience).

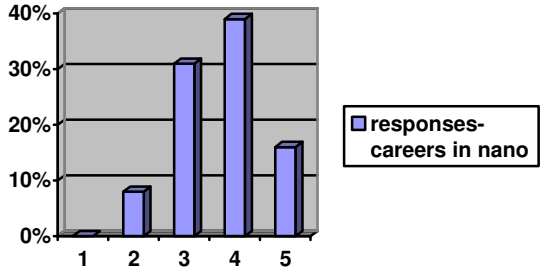
Since its inception in 1997, the NNIN REU program has had over 500 participants. As noted above, the program began under the NNUN and expanded to twelve sites with the inception of the NNIN. During 2006, we began a longitudinal study to determine the educational and career path of interns who participated in the program in the first seven years (1997- 2003). Measuring the impact of our program on career choices is challenging because it plays out over the course of ten years after the REU experience. Students who were sophomores, juniors, or seniors in 1997 would not enter graduate school or the workplace until one to three years after the program and would not complete terminal degrees until 2006-2007 (assuming a typical education track of two years for a master's degree and five years for a doctorate).

We have chosen the 1997-2003 period because participants will have graduated from their home institutions and will have entered or completed additional education and/or entered into the workforce. These participants will have been in programs at the five NNUN sites. This study is

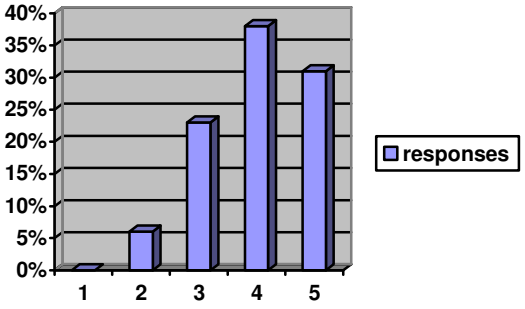
a labor intensive analysis as participants have moved, changed names, and even home addresses are no longer valid due to family moves. Methods of contact have included e-mails, letters, web searches, and a link on our website. Face Book and MySpace are excellent resources for fiding past participants. Approximately 80% of 2007 participants have pages on one of the social networking sites. Of the 250 participants we have contacted nearly 100 (n=96) have completed the online survey. We are continuing this study and believe the highly positive results are not only of importance for the NNIN program but also for other undergraduate research programs in general. We have a link on our web site where former 1997-2003 participants are directed to "click in" and complete the survey. To date, there have not been any respondents from summer 2003. Below are results for some of the questions that allow us to see how the NNIN REU program has played out over the years for past participants. For responses on a Likert scale, the response choices are as follows: 1) not at all; 2) limited; 3) somewhat; 4) significantly; 5) very significantly.

Question 1 – Did the program provide you with experiences that allowed you to see the breadth of nanotechnology applications and possible careers in nanotechnology?





Question 2 – Did the program assist you in making future educational and career choices?



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Question 3 – Did the program influence you (or reinforce your choice) to pursue education or a research career in science, mathematics, engineering or technology?

Response choices	**Answer**
Yes, influenced me to pursue/continue to pursue a science/technology research career	69.5%

Influenced me NOT to seek a science/technology research career	5.3%
Influenced me to NOT seek any type of science/technology career	0.0%
Did not influence my career choice significantly	14.7%
Other (examples) • Influenced me to seek a science/technology career not necessarily in research • Influenced me to get my PhD • Influenced me positively, but in the end I decided not to seek a research career. • Influenced me to pursue a legal & public policy career towards science and technology development • Influenced me to pursue an engineer/application career	10.5%

Question 4 – What has been your education path since the REU experience?

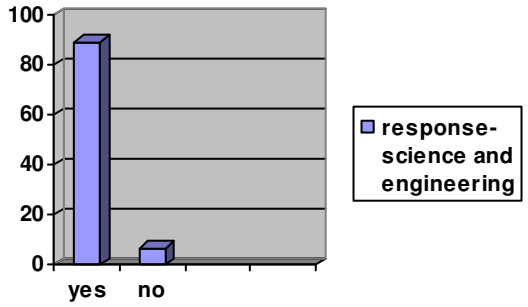
Choices	**Response**
Did not finish college	0.0%
Stopped with BS/BA	11.5%
Completed (or working on) terminal Masters Degree	31.3%
Completed (or working on) Ph.D.	39.6%
Completed (or working on) Law degree	4.2%
Completed (or working on) M.D. or other medical degree	5.2%
Other (please specify)	8.3%

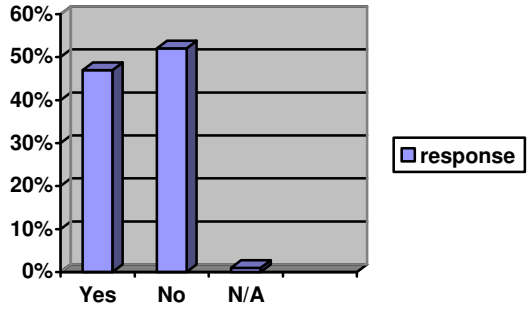
Question 5 – What is your current employment/education situation (if in transition, check where you are going)?

Choices	**Response**
Still in school	37.5%
Large company	24.0%
Small company	15.6%
Government	8.3%
University employment (faculty, staff, post-doc	5.2%
Self-employed	0.0%
Not employed	0.0%

Other (please specify) • Post-doc • Working (company &/or government lab) and graduate school • Large school district	9.4%

Question 6 - Does your current (or expected) position involve science and engineering in any form? Does it involve nano (broadly defined)?





Question 7 – If you are employed in a science and engineering position, please describe.

Choice	**Response**
Research & development/laboratory/design	53.0%
Manufacturing & production support	10.6%
Consulting	4.5%
Sales & service	4.5%
Education	7.6%
Other (please specify)	19.7%

Question 8 - Has your opinion of your REU experience changed significantly over the years?

Choices	**Response**
No	52.6%
Yes, time has increased my opinion	46.3%
Yes, time has decreased my opinion	0.0%
Other (please specify)	1.1%

The above results represent a response rate of about 40% for the 1997-2003 NNIN REU participants. While not extremely high, they do represent a fairly good yield for a program going back over ten years. In addition, these results have been extremely labor intensive to obtain. We believe that the longitudinal surveys provide an interesting and important glimpse at REU participants several years after they have completed their summer experiences. One important result involves Question 3 - Did the program influence you (or reinforce your choice) to pursue

education or a research career in science, mathematics, engineering or technology? Nearly 70 % of the respondents indicated that the program influenced them to pursue a STEM career. This is also obtained anecdotally through conversations with participants. Frequently we are told that the program has "convinced" them to continue on in graduate school in science and engineering. The survey results appear to confirm these "verbal" commitments often made during the excitement of program participation. The results of these surveys demonstrate that the NNIN REU program does excite undergraduates about possible education and career opportunities in STEM and that these participants are entering the STEM education and workforce at high rates. We believe that the results presented herein demonstrate that well-organized and well-supported REU programs have a positive influence on education and career paths of the participants. It is important to note that 46% of the past participants indicated that time had increased their opinion of the REU experience. It would appear from the responses for Question 8 that the positive impact of the NNIN REU program goes well beyond the year of participation.

Future Work

This study is being continued through additional attempts at reaching more of the participants in the first seven years of the program. The next step in our analysis is also to examine the career paths of the female and minority participants who have responded to the surveys. We have not broken out these participants and have only used the aggregate numbers for our initial analysis. The results presented here indicate that the NNIN REU program is providing a high quality research experience which positively influences future education and career choices.

To extend this experience we have developed a second year program for our participants. Students who participated in the summer of 2007 were eligible to compete for eight international positions and seven positions at U.S. federal laboratories. We will continue this program with the prior summer's interns eligible for positions the following summer. Three students will be in a joint program at the Helmholz Research Institute at Jülich, Germany and five will be at National Institute of Materials Science in Tsukuba, Japan. Two students will do research in summer 2008 at Sadnia National Labs and five will be at the National Institute of Standards and Technology. We believe that providing the NNIN REUs with a second nanotechnology research opportunity will enhance and sustain their interest in pursuing graduate school in STEM. The international experience will allow interns to gain a global perspective of research while the national lab experience will provide insight into government-sponsored research facilities.

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