

Enhancing the Global Perspective of REU Site Students

Abstract

Developing a diverse, internationally competitive and globally-engaged science and engineering workforce is one of the goals of the National Science Foundation. In this paper we describe our motivation for and experience with incorporating an international component into our NSF-funded summer Research Experience for Undergraduates (REU) site. Our experience shows that including international students in our REU program is relatively inexpensive and highly beneficial to all participating students and to the educational institutions that the students attend. This paper includes guidelines for dealing with the most important issues related to incorporating international students into an REU program, as well as some conclusions which may be beneficial to other REU programs.

1. Introduction

The Research Experiences for Undergraduates (REU) program supported by the National Science Foundation (NSF) is designed to provide academic experiences for undergraduate students through participation in research. The program contributes to NSF's goal of developing a diverse, internationally competitive, and globally-engaged science and engineering workforce¹.

Under this program, the Department of Computer Science and Engineering at the University of South Florida has run a unique NSF REU site -- *A Computer Science and Engineering REU Site for Florida, Puerto Rico and Latin America*², for the past two years. Compared to other REU sites, this program is unique in the following ways. First, it is not devoted to a particular theme or topic. Instead, it gives students a broad range of research project options in computer science and engineering. For example, the program includes research projects in robotics, computer networks, transportation, computer architecture, data mining, artificial intelligence, real-time software verification, game programming and digital image processing. The second distinctive aspect is that the program is committed to recruiting the majority of the students from minority groups, and Hispanics in particular, mainly from Puerto Rico and Florida. This is motivated by well published statistics that show very low participation of under-represented minority groups, especially Hispanics, in careers in engineering and computer science, in tenure-track faculty positions in those fields, and in industry and government leadership positions. The third distinctive aspect of the program is the commitment to recruiting at least one international student from a Latin American country. Since foreign students are not eligible to receive NSF funds, other funding mechanisms have to be used for this aspect of the program. In this paper we focus our attention on this international dimension of the program, describe our experiences, and provide recommendations for incorporating this innovative feature into an REU program.

Although International Science and Engineering REU site³ programs already exist, they are meant to provide educational opportunities and experiences in other countries for U.S. students. In contrast with these programs, our REU program includes international students who interact with U.S. students here in the United States. We maintain that adding this component is highly beneficial to all the participants in this type of program as well as to the educational institutions

that these participants attend.

In addition, we have found that the cost of incorporating this international component into the program is relatively small when compared with the benefits it brings. As far as we know, this is the only REU program that includes such an international component, and the experiences we have gained from this may be useful for other programs.

Section 2 of this paper provides a brief description of our REU site, its objectives, the activities offered for promoting cultural interaction, the group of participants, and the publications generated from this program. Section 3 gives more detailed reasons for including international students in the program, while Section 4 includes guidelines for selecting the international educational institutions that the students come from, as well as other important issues, such as immigration and the cost of supporting the students. Section 5 summarizes the students' responses taken from surveys and individual interviews, and Section 6 describes the benefits and drawbacks of running a program which includes international students. In Section 7 we present our conclusions.

2. Program Description

As most REU sites⁵, our site -- *A Computer Science and Engineering REU Site for Florida, Puerto Rico and Latin America*, established at the University of South Florida, is a 10-week summer program funded by NSF. This program seeks to achieve four main objectives⁴. The first objective is to increase student involvement from under-represented minority groups, with an emphasis on Hispanic students from Florida and Puerto Rico. The second objective of the program is to better prepare undergraduates for their professional careers. Toward achieving this objective, the activities implemented involve students in research projects where they learn about investigative methods and cutting-edge tools in their fields as well as in activities meant to improve their writing and oral skills. The third objective is to make these students aware of the opportunities that are available in graduate programs by providing the participants with relevant and timely information about graduate program application procedures, deadlines, requirements, and funding opportunities. The fourth objective is to improve the students' ability to learn independently.

Social and educational activities play an important role in this program. These activities promote social integration and academic discussion among participants as well as cultural exchange and friendship. Social activities in our program include: pool parties, welcome and closing lunches, visits to recreational parks and shopping centers, and small trips to well known entertainment and cultural venues. Educational activities in our program include: workshops on poster design and oral and written presentation skills, seminars in library research techniques, group discussions on professional ethics, advising sessions on graduate program application procedures, deadlines, requirements, and funding opportunities. In addition, visits to the Museum of Science and Industry and the Nanotechnology Center at USF have been part of the program. Mid- and end-of-program project presentations, a poster competition, and a written research paper are the main program requirements.

A total of 26 students have participated in this program since its inception 2 years ago, and we

feel that so far the program has been very successful in meeting its objectives. Table I shows that 64% of all participants have been members of under-represented minority groups. One African American and two Hispanic participants, after graduating from their respective universities, have enrolled in our Ph.D. program. The rest of the participants have either graduated and are pursuing careers in industry, or are still successfully attending their universities. We have disseminated our findings via several educational publications. Among these publications there are two technical conference papers with the REU students as first authors. More detailed information about the program can be found at: <http://www.csee.usf.edu/REU>.

Table I. REU participants 2005-2006.

Country	2005	2006	Total	
Hispanics Puerto Rico	6	5	11	42 %
Hispanics Other	2	1	3	11 %
African American	2	1	3	11 %
Whites / others	0	4	4	16 %
International	2	3	5	20 %
Total students	12	14	26	100 %
Women	3	4	7	27%

3. Benefits of Including International Students

Contributions to the REU Program's Objectives

The inclusion of international students contributes to achieving many of the objectives set forth by our program. International engineering students from most Latin American universities are enrolled in five-year programs and as a result, those students in their last year of study are very well prepared academically with a level of knowledge and courses taken similar to our master's degree level students. Thus, our U.S. undergraduate students participating in this program can learn from these international students' technical expertise while collaborating on common projects. In addition, the insight into Latin American culture gained by the U.S. students will better prepare them for their careers, especially in a global industrial arena. The REU program, because of its inherent strengths, enables all students, whether they be international or national, to develop their capability for learning independently. This was apparent in the answers to the personal interviews and survey instruments used for assessment at the end of each summer program. As far as motivating students to consider enrolling in graduate programs, two of the students (one of them is an international student) have already enrolled in our Ph.D. program and two more are in the application process.

Benefits to the Students

Including international students provides benefits to all of the students involved. Among the many benefits gained by students in this program, cultural exchange is one with far-reaching effects. When U.S. students visit another country and interact with the local people, these students have the opportunity to expand and share their knowledge, forge new relationships, learn about other cultures and languages, and learn different ways to solve and understand

problems. We believe that similar effects occur when students from other countries visit the United States. As a result, both the international and U.S. students in our program obtain these benefits from this international dimension. International students are always attracted by the quality of life and education in the U.S., and many want to return to continue their studies here and become more acquainted with the U.S. culture. Living in an increasingly global world, U.S. students have become more interested in other cultures and in learning another language. Because of Florida's proximity to the Caribbean and to Central and South America, Spanish is their most logical language choice. And even more importantly, becoming proficient in another language is as important for the international students as it is for the U.S. students. English has become the international language for business and education, and this is even more important in Latin American countries, since the U.S. is perhaps the most important commercial partner in most of these countries. Similarly, understanding Latin American culture and the Spanish language are equally important for Americans because of the same commercial needs. In addition, according to the U.S. Census Bureau⁶, one quarter of the total population of the U.S. will be Hispanic by the year 2050. Therefore, understanding each other's culture and language will give these future professionals, in this hemisphere and elsewhere, an important competitive advantage.

Benefits to the Educational Institutions Involved

From the educational institutions' perspective, there are also several benefits. First and foremost, a strong institutional relationship is in place after the REU experience, leading to new opportunities for collaboration in academic and research areas. As stated by the National Science Board⁷, "Collaborative activities and international partnerships contribute to building more stable relations among communities and nations by creating a universal language and culture based on commonly accepted values of objectivity, sharing, integrity, and free inquiry". As an example of these collaborative initiatives, in the fall of 2006, with the support of the *Universidad de Antioquia* in Colombia and the Ibero-American Science and Technology Education Consortium (ISTEC)⁸, we taught a three-day workshop on wireless sensor networks at that Colombian university. The students who came from that university to participate in the USF REU program in the summer of 2006 were essential collaborators in this workshop, since they had worked in this area during their REU experience at USF. After the workshop, the *Universidad de Antioquia* started a wireless sensor network laboratory for education and research in this area. With this type of activity we not only helped the *Universidad de Antioquia* get started in new technologies and improve its curriculum, but we also found professors with whom we could collaborate on research activities and student recruitment. The same workshop is expected to be taught at the *Universidad del Norte* in Barranquilla, Colombia and at the *Universidad de Aquino* in Bolivia. Similarly, after the participation of the students from the *Universidad del Norte* in the summer of 2005, we signed an agreement with this university to offer a dual degree program that allows Colombian students in their senior year to become USF students and finish their studies at our university and end up with two degrees.

Finally, the international students have been very valuable contributors to the research projects to which they have been assigned at our university, and they have been able to publish these results in conference papers and in journals⁹.

4. Bringing International Students into the Program

In this section, we provide several recommendations for those who want to successfully implement a similar initiative. Recommendations on how to find funds, and select and bring talented international students to the program are included.

Finding Resources

NSF funds to support an international dimension are mainly given for the participation of U.S. students at REU sites outside of the United States. A useful guide for these REU overseas sites was presented in the Workshop on Best Practices for Managing International Research Experiences for Undergraduates¹⁰. However, our goal was to create this international experience in which students from other countries participate at an REU site located in the United States. As a result, sources of funding other than NSF were needed to support this component of our REU program.

Table II shows an estimate of the cost involved in bringing one international student to participate in our REU summer program. Finding \$7,500 to support one international student is relatively easy if both the local and international educational institutions are convinced of the benefits that this exchange will bring. In our case, the College of Engineering at USF committed to supporting one international student every year. We have utilized these funds to negotiate "matching" funds with selected international universities and have been able to bring twice as many international students into our REU program. Other possible sources of funding are externally funded research grants, scholarships funded by international educational institutions, and finally, sometimes students are willing to pay their own way in order to have the opportunity to participate in this program. We have made use of all of these funding options, and in two years with funds from USF to support two students, we have been able to bring a total of five international students into our REU program.

Table II. Cost of funding an international REU participant in 2006.

Item	Cost
VISA (including trip to embassy)	500
Health insurance	250
Travel expenses	550
Stipend	3,200
Meal stipends	1,500
Housing	1,500
Total	US\$ 7,500

Two aspects are important to highlight here. Having personal knowledge of universities and professors in other countries is a big advantage. Normally, we advertise this international opportunity to known professors at selected universities in several countries, and receive more applications than there are positions available. In the end, we provide opportunities to those educational institutions that are better able to support the students financially and that offer a better possibility for collaboration among the institutions. Our experience has been very positive

with both public and private international educational institutions.

Defining the Selection Criteria for Students

Before contacting international universities, it is necessary to define the criteria for student selection and the funds for financial support of the students. In terms of student selection, we require students to be in their last year of undergraduate studies at their university with a background in Computer Science or Electrical Engineering. These criteria along with a description of the summer REU program, available research projects, dates, etc., are included in the *call for participation* document, which is later sent to the selected international universities along with a flier for advertisement purposes. This document also specifies what is expected from the institutions in terms of funding for the students. In our case, we ask the international institutions to cover the visa, health insurance, travel expenses, and part of the stipend shown in Table II.

Selecting International Educational Institutions

Outstanding students mostly belong to well-ranked universities. In most of Latin American countries, ranking is given by a number of different accreditation organizations such as: *Consejo Nacional de Acreditación - CNA* in Colombia, *Comisión Nacional de Acreditación de Programas - CNAP* in Chile, *Sistema Nacional de Acreditación de la Educación Superior - SINAES* in Costa Rica, *Consejo para la Acreditación de la Educación Superior - COPAES* in México, and *Comisión Nacional de Evaluación y Acreditación Universitaria - CONEAU* in Argentina. These Latin American accreditation board sites are the main sources of useful information for making this selection. Another avenue for selecting these universities is to choose from those universities with which the U.S. educational institution has agreements. Particularly, USF is a member of the Ibero-American Science and Technology Education Consortium (ISTEC), and many of the well-ranked Latin American universities are also part of this consortium. The third source of information comes from personal knowledge and existing relationships with universities and professors. In some cases this may be the most effective selection tool. All selected institutions are then sent the *call for participation* document and flier.

Selecting the International Students

In each of the two summers that our program has included international students, the international universities have used their own criteria for selecting their student candidates who would participate in our REU program. The most common factors used in this selection have been: GPA, experience in research, and personal information about the students that allow the universities to determine which students are most likely to be successful in the program. They are very mindful of the fact that these students will also serve as representatives of their institutions. From the list of candidates sent to us we make a final selection based on research projects available in the REU program, the research interests of the students, and specific skills required by these projects. In all cases they have always presented us with a list of top quality students who, after being selected, have had a very successful experience here.

VISA Procedures

International participants need to obtain an appropriate visa to attend the summer program. In this regard, the *Exchange Visitor* visa (J1 category) for international educational and cultural exchanges is the most convenient one. To begin this process, personal and financial information forms are sent to the students. These forms, correctly signed, are then sent to the international admissions office at USF, which then issues a DS-2019 form so the students can go to the American embassy or consulate in their countries to obtain the visa. In contrast to other J1 visas for extended periods which require that the individual return to his home country for two years before soliciting another type of US visa with the exception of the tourist visa, this J1 visa for the short summer program allows the students to return to the US for graduate studies using an F1 student visa. In addition, the J1 visa seems to be easier to obtain. According to the U.S. Department of State, for the fiscal year 2005, only 11.6% of the J1 visa applications were refused compared with 28.6% of the F1 visa applications¹¹.

Program Activities

International students participate in all the social and academic activities scheduled for the REU summer program. It is very important for those activities to promote the development of cultural interaction. Therefore, international students are intentionally housed in the same on-campus apartments with the other REU students.

The first week of the program offers many opportunities for all students to get acquainted. Starting with an orientation meeting and welcome lunch, the students meet their research project partners, research mentors, and departmental and college representatives. During this week, they make their first foray into the local community to buy supplies for their stay in their apartments, which represents the first cultural experience and exchange. At the end of the week, they also meet students from other REU programs running at the same time at the university at a welcome pool party. That is also a wonderful opportunity for cultural exchange.

After that, workshops, technical and recreational visits, public presentations, parties, and many other social and educational activities promote the development of the international dimension in the program. The last week of the program is a full-time week of final presentations, competitions, paper and final report submissions, closing lunch, final surveys and check-out from the apartments. For a detailed list of activities, please visit <http://www.cse.usf.edu/REU>

5. Program Evaluation

Specialists from the USF Center for Research, Evaluation, Assessment, and Measurement (CREAM) have assisted us in formally evaluating the REU program for two summers in a row. These specialists have designed survey instruments for this purpose and have assisted us in analyzing the data collected. Personal interviews and the survey instrument shown in Table III were designed specifically to obtain the opinions of international and U.S. students about the program, its international dimension, and their overall experience.

The analysis of the data collected from these surveys shows very positive results. For all the international students, this was their first academic experience outside of their country. In terms of funding, they felt the stipend received from the College of Engineering was enough not only

to live on in the U.S. but also was enough to participate in social activities. Regarding the research experience, they felt that the program helped them enhance their professional skills and would help them successfully complete their bachelor's degree. One of the students evaluated the program as a unique and challenging opportunity. This student said, "This experience gives us the opportunity to demonstrate what we can do". They felt that the education received in their countries prepared them well enough to successfully complete the research project assigned, and to enroll in a graduate program in the U.S.

Table III. Survey instrument.

REU experience at USF	Option 1	Option 2	Option 3	Option 4
Had you ever studied outside of your home country?	Yes	No		
As a J1 visitor, did you have any immigration issues?	Yes	No		
How satisfied are you overall with your stay in the U.S.?	Very satisfied	Satisfied	Dissatisfied	Very Dissatisfied
Most of the friends you made are from...	Your country	US	Puerto Rico	Another country
Was the education received in your country adequate enough to succeed in your project?	Yes	No	Unsure	
Does this experience contribute to you successfully completing your bachelor's degree?	Not at all	Somewhat	Definitely	
How does this experience change the idea you had about education in the U.S.?	Positively	Negatively	No change	
Does this experience motivate you to enroll in a graduate program in the U.S.?	Yes	No	Unsure	

Both U.S. and international students felt that their mutual interaction gave them a broader perspective on education and culture in other countries. Social activities developed by the program and those derived from living together in the same apartments for an extended period of time gave them a better appreciation of their cultural similarities and differences.

6. Opportunities for Improvement

It is important to acknowledge that implementing this international dimension in the REU program requires several additional administrative procedures in order to bring these international students here. Visa documents, selecting the international educational institutions, interactions with those universities and professors, and selecting the students are among the most important and time-consuming activities.

There are several opportunities for improvement with respect to this international dimension of

the program. Some of the international students had a low English proficiency level which led to communication issues. Therefore, it is imperative that the results of an English proficiency test be included in the application package and be considered as part of the selection process. Another opportunity for improvement is in the selection of research teams. International students should be paired with U.S. students as research project partners thus promoting academic and social interaction, as well as giving the international students an opportunity to improve their command of English.

7. Conclusions

In this paper we describe our motivation for and experience with adding an international dimension to our summer NSF REU site. In general, we can conclude that this is a low-cost and highly beneficial initiative for all the participants contributing positively to many of the original objectives of the program. The U.S. students found this to be a valuable experience that provided them with a broader and better perspective on education and culture in Latin American countries. From the international students' perspective, the experience was also highly positive. They did not face any funding, cultural, or academic problems that prevented them from being successful in the program. From the perspective of the educational institutions, this initiative has strengthened the links between them, opening up a series of educational and collaborative research opportunities.

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Bibliography

1. NSF Research Experiences for Undergraduates (REU) Program, <http://www.nsf.gov/home/crssprgm/reu/>.
2. Computer Science and Engineering REU Site at University of South Florida, <http://www.csee.usf.edu/REU/>.
3. NSF International Science and Engineering REU Sites, <http://www.nsf.gov/crssprgm/reu/listresult.cfm?unitid=10003>.
4. M. Labrador and R. Perez, "Fulfilling Mentors' Expectations: An REU Site Experience", Proceedings of ASEE SE, April 2006.
5. NSF REU Sites, http://www.nsf.gov/crssprgm/reu/reu_search.cfm.
6. C. Llagas, "Status and Trends in the Education of Hispanics", <http://nces.ed.gov/pubs2003/2003008.pdf>, April 2003.
7. "Toward a More Effective NSF Role in International Science and Engineering", available at <http://www.nsf.gov/publications/pubsumm.jsp?odskey=nsb00217>.
8. Ibero American Science and Technology Education Consortium, <http://www.istec.org/>.
9. S. Barbeau, M. A. Labrador, P. Winters, R. Perez, and N. L. Georggi, "A General Architecture in Support of Interactive, Multimedia, Location-Based Mobile Applications", IEEE Communications Magazine (to appear), November 2006.
10. "Looking Beyond the Borders: A Project Director's Handbook of Best Practices for International Research Experiences for Undergraduates", available at <http://www.nsfkyo.org/REU/>.
11. U.S. Department of State. Nonimmigrant VISA Workload Fiscal Year 2005, http://travel.state.gov/visa/frvi/statistics/statistics_1476.html.