



**Research
News On
Graduate
Education**

**Volume 2
Number 3
July 2000**

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**Managing
Editor:** Yolanda S.
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quarterly (April, July,
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and Human Resources

FROM THE EDITORS

Each issue features a profile on an institution that received an NSF Alliances for Graduate Education and the Professoriate (AGEP) award. This month we are pleased to feature an article highlighting the AGEP program at the University of Puerto Rico by Brad Weiner. Dr. Mary Louise Soffa, a Computer Science Professor at the University of Pittsburgh, took the time to chat with us this month about her experiences as a professor and mentor.

Dr. Shirley Malcom contributes the lead article in this issue. Her paper is based upon presentations she made at our Atlanta Workshop 2000 in February and at a special symposium on human resources held during the American Chemical Society Meeting in San Francisco, March 2000.

Dr. Barbara Lovitts, American Institutes for Research, shares a short piece from her book (in press) *Leaving the Ivory Tower: The Causes and Consequences of Departure from Doctoral Study*.

Let Us Know What You Think

Please continue to send us your comments, feedback and inquiries. After all, the goal of this newsletter is serve the needs of its readers. If you are interested in submitting a research article, please contact Ginny Van Horne at gvanhorn@aaas.org. For further information on our work, visit: <http://nsfagep.org>.

Program. Its purpose is to share information about minority graduate education in the fields of science, mathematics, and engineering. It is available in print and electronic format. Inquiries, information related to AGEP, and all correspondence should be sent to the editor.

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**Minority Ph.D. Production in SME Fields:
Distributing the Work?**

*By Dr. Shirley M. Malcom, American Association for the
Advancement of Science, Head, Directorate for Education
and Human Resources Programs*

Science and engineering communities have expressed enthusiastic support for the FY 2001 budget proposed by President Clinton. This budget calls for a \$1B increase in support for the National Institutes of Health as well as the largest dollar increase ever proposed for support of research and education at the National Science Foundation. This budget is based on a growing realization by the Administration and the Congress of the contribution of science and technology to our economic prosperity as well as to our quality of life. Federal Reserve Board Chairman Alan Greenspan has noted in recent speeches and articles the importance of the new technologies to the unprecedented prosperity and economic health which the U.S. is enjoying. And support for basic research within the Congress has been strongly bipartisan. Whether this rhetorical support is translated into real dollars, however, must await the resolution of the political process in a presidential election year.

When tax dollars are used in support of science, what do citizens get for their dollars? Collectively, there is a gain of research on health, energy, environment, telecommunications and many other areas that can lead to new products, security, clean water, safe and abundant food, cures and treatment for disease, better understanding of human-kind, the Earth, solar system and the cosmos-of the things around us, both large and small. This research has been a major contributor to innovation and national well-being.

As important as the knowledge, the new ideas and technologies is the production of people that accompanies and supports the conduct of research and development. People are not just a by-product of research but indeed are

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the enduring product as researchers and teachers pass their knowledge and understandings from one institution and from one generation to another.

A recognition of the importance of the human resources dimension of the research investment has been fully acknowledged in the strategic plan of the National Science Foundation. It emphasizes the primacy of the integration of research and education as an investment strategy. In keeping with this goal the criteria advanced by the National Science Board (NSB) for evaluation of proposals were changed several years ago to recognize an expanded view of merit that includes the technical and infrastructure (including human resources) components to this investment of public dollars. It is not clear how well these criteria have been addressed in the review process to date, but the intent of the change was clear.

Many of the same concerns that the NSB discussed in its strategic planning and criteria review regarding the adequacy of the human resources base and the long term health of science likely drove the Congress to put in place the Minority Graduate Education program now known as the Alliances for Graduate Education and the Professoriate Program. Major shifts underway in the demographics of the United States move us toward increased proportions of college students, graduates and workforce participants from those groups that have had weak traditions and lower levels of participation in SME fields, this at a time when demands for talent in fields such as information technology and many areas of engineering are at an all time high. As the demographic shift affects the makeup of the college and university population, the direct impact of low graduate production for minorities (and in many fields for women as well) is starkly evident in the SME faculty: few minorities; fewer still at high rank; and fewest at high rank in major research universities.

Where minority SME faculty are present to what extent do they carry a disproportionate share of the responsibility for contact and for serving as a role model to minority students? At a symposium on human resources held at the 2000 AAAS Annual Meeting in Washington, D.C., Dr. Charlotte Kuh, Director of the National Research Council's Office of Scientific and Engineering Personnel, introduced the concept of "faculty burden." This refers to the relative role that faculty from underrepresented groups might play in their contact with students from underrepresented groups as they function as role models. Certainly the concept bears on the tasks that are undertaken and/or assigned to such faculty in their "representational roles" as well.

Producing Future Faculty

So where does the responsibility rest to produce the number of minority PhDs we need as the demographic makeup of the college age population shifts? And where should the responsibility reside? Many would argue that those institutions that receive large amounts of federal funding for research should be expected to produce the research and the next generation of researchers. To what extent do those institutions that receive significant public research dollars participate in meeting the national goal of developing minority researchers? How much overlap exists across the list of top funded institutions and top producers of African American, Hispanic and Native American SME Ph.D.s? [Table 1](#) provides a list of the Top 20 institutions receiving federal funding in 1997 and their rank in overall production of SME Ph.D.s in 1997. By examining other trends, we know that several trends are notable: the dominant effect of funding from the National Institutes of Health as a driver on the rankings and the strong relationship between size of the research enterprise and amount of Ph.D. production. Eighteen of twenty of the top federally funded universities are ranked in the top fifty Ph.D. producers. Sixteen of twenty have medical and/or veterinary programs associated with their research enterprise.

Viewed in the opposite way, one looks instead at the federal research funding of major Ph.D. producing institutions and finds that all of the top 20 SME doctorate producing universities rank among the top 50 institutions receiving federal research dollars. ([Table 2](#))

Production of SME Ph.D.s is comprised of citizens and non-citizens and the list in [Table 2](#) represents a combined total. If one considers only U.S. citizens and permanent residents, the institutional rankings shift somewhat. But the overall relationship reflecting the integration of research and education is retained.

Ph.D. Production for U.S. Minorities

How are Ph.D. producing institutions doing with respect to the Ph.D. production of African American, Hispanic and American Indian citizens? Only two of the top producing institutions also appear on all three lists as top SME Ph.D. producing institutions of African Americans, Hispanics and American Indians-University of Michigan and University of California, Berkeley. Three of the top twenty institutions for SME Ph.D. production for U.S. citizens and

permanent residents did not appear among the top ranked Ph.D. producers for any of the three minority groups- University of Wisconsin, University of Minnesota, and Texas A&M University. [Note that this means they awarded fewer than eight doctorates to African Americans, fewer than eight doctorates to Hispanics and fewer than two doctorates to American Indians in all the computational, natural, social and behavioral sciences and engineering fields in 1997.]*

*In examining the data the author elected to look at the top twenty Ph.D. producing institutions. Eight was the natural "cut point" for African Americans and Hispanics. While a number of institutions produced one American Indian Ph.D., this was not considered representative of "institutional effort."

Several policy questions emerge from this analysis:

- Both University of Michigan and UC Berkeley have been challenged regarding use of affirmative action in admissions and financial aid decisions. In this regard, as public institutions they are especially vulnerable to legal challenge. While private institutions may have more flexibility, it is not clear that they will step in to assume a leadership role (see [Table 3](#)). Without regard to their use of these strategies in graduate programs, to what extent does the challenge itself pose a danger to the efforts within the institutions for SME graduate education of minorities?
- Since institutions with more modest federal support shoulder a disproportionate share of the responsibilities for the education of minority graduate students what policies might be put in place to support these efforts, e.g. capitation payments?
- Since institutions receiving large investments of public dollars for research are under-producing minority Ph.D.s relative to their resources, how might alliances re-distribute responsibility for training?
- How can "track record" in the successful production of minority SME Ph.D.s be factored into review of large scale grants, especially where the "production of research and the next generation of researchers" is a stated policy goal?
- What policy incentives would engage institutions more aggressively in Ph.D. production of minorities? How does one more fairly share the work? Or does

one move to consider how to distribute more wealth to those institutions doing more work? At least the challenge from the Gospel of Luke might be considered: "For unto whomsoever much is given, of him shall be much required; and to whom men have committed much, of him they will ask the more" (Luke 12:48).

Looking inside One Field

One of the major findings of the AAAS study, *Losing Ground*, (1998) was the extent to which the decentralized nature of graduate education within universities increases the level of the challenge associated with enhancing minority graduate education. Small numbers coupled with uneven effort across fields and departments exacerbate effects of the uncertain policy climate in which graduate education of minorities gets considered.

Looking within one field gives us a different vantage point from which to view relative effort. Chemistry was selected as the field to consider for this purpose: there is a robust job market for persons holding graduate degrees that includes industry as well as academia; there are strong targeted efforts and organizations supporting minorities in chemistry. Chemistry does not have the problem of very low production that physics has, nor the challenge of a fragmented professional community as with the biological sciences.

Minority graduate enrollment in chemistry is heavily driven by the minority serving institutions. Seven Historically Black Colleges and Universities appear among the top nineteen chemistry programs enrolling African Americans; chemistry enrollment numbers for Hispanics are dominated by two campuses of the University of Puerto Rico (Rio Piedras and Mayaguez) whose combined total nearly equals that of the combined enrollment of twenty programs ranked below them (166 vs. 168 students). For American Indians, Oklahoma State was the clear leader with seven students in the chemistry program ([Table 4](#)).

While factors such as geography, masters vs. doctorate programs, and critical mass likely affect enrollment figures so too do leadership and the efforts of individual faculty. Large, well-funded programs are not necessarily diverse programs when considering the presence of American minority students.

Next Steps

One might imagine both institutional incentives and national strategies to alter the makeup of departments, such as adding funding to programs that successfully recruit, mentor and graduate minority students, or providing endowed chairs for successful mentors. AAAS and Presidential mentoring awards provide cash and recognition to individuals and/or programs. For the chemistry community special efforts within the American Chemical Society have raised the visibility of these issues. And chemists have been very successful in being recognized by the AAAS Award.

It is not clear to what extent these factors of "the human infrastructure for science" are considered in funding decisions along with more traditional and more narrow views of "technical merit."

While the challenges of Ph.D. production of minorities are often taken on by individuals as matters of personal responsibility, questions remain as to the roles and responsibilities of institutions, professional communities, federal funding agencies and the business and philanthropic communities in addressing the human resources needs in SME that loom on the horizon. Robert Merton, sociologist of science, introduced the concept of cumulative advantage to describe the making of a scientist as a process by which early opportunities for education and experiences build, leading to more and more such opportunities. Drawing on the Gospel according to Matthew, "Whoever has been given more and he will have an abundance." Matthew has a flip side as well (that of cumulative disadvantage): "whoever does not have, even what he has will be taken from him" (Matthew 13:12). While Matthew may have described the current process of the making of a scientist and the community's mechanisms for distributing opportunities and judging outcomes (as well as the failures in this process) perhaps we must look as well to Luke for answers of how to proceed in the next millennium to expand the talent pool.

This paper is based on presentations by Shirley Malcom at the Workshop 2000 conference in Atlanta, Feb 24-25, 2000 and at a special symposium on human resources held during the American Chemical Society Meeting in San Francisco, March, 2000. Special thanks to Eleanor Babco, Director of the Commission on Professionals in Science and technology, for special data runs she did to support these presentations, as well as to Daryl Chubin, Senior Policy Associate, National Science Board, for painstakingly reviewing this article and providing feedback.



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Context and Attrition

*By Dr. Barbara E. Lovitts, Senior Research Analyst,
American Institutes for Research*

Despite increased attention to doctoral student retention, graduate schools have faced persistently high attrition rates. Studies on persistence going back to 1950 (Tucker, 1964) show a consistent pattern of attrition by discipline (Benkin, 1984; Berelson, 1960; Bowen & Rudenstine, 1992; and Tucker, 1960). The sciences exhibit the lowest attrition rates (roughly 30 to 50%), the humanities the highest (roughly 50 to 70%), with the social sciences falling somewhere in between (roughly 40 to 65%). Please see Figure 1. The variability in the attrition rates within discipline reflect not only variation in data collection methods, but, more importantly, variation among the departments from which the data were collected. A twofold problem thus arises: how to explain the consistent pattern of attrition exhibited by the disciplines while at the same time explaining variation in rates of attrition across departments within a discipline. This paper presents a theoretical explanation for the stable rates of doctoral student attrition in terms of integration and assesses empirically how differences in structures and opportunities for integration within departments lead to observed differences in attrition rates across departments within disciplines.

**The Relationship Between Attrition Rates and
Disciplinary Structures**

Standard rates across time reflect social structures and social forces that remain relatively unchanged from year to year (Durkheim, 1897/1951). These forces must be independent of individuals because the force acts with the same intensity, achieving the same end in the same numbers, on individuals who do not form a natural group and who are not in communication. Similarly, to paraphrase Durkheim, the regular recurrence of identical events in proportions constant within the same discipline

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but very inconstant from one discipline to another would be inexplicable if each discipline did not have a similar structure which affected its members with a similar force. Thus, one could expect standard patterns of variation of attrition across disciplines because of systematic differences in their intellectual and social structures.

A discipline's social structure is in large part determined by its intellectual structure. Intellectually, the sciences are highly structured disciplines. Their subject matter is vertically integrated and graduate students focus on mastering one or a few contemporary theories. Doctoral students in the sciences often chose, or are chosen by, an advisor by the end of their first year, and begin research on projects that will serve as the basis of their dissertations. Much of this research is done in teams, which ensures that doctoral students in the sciences are in frequent academic and social contact with faculty and fellow graduate students. (Bowen & Rudenstine, 1992; Wilson, 1965).

The humanities and many of the social sciences, by comparison, are more loosely structured. Their subject matter is horizontally integrated. Students in these disciplines frequently do not select an advisor or commence dissertation-related re-search until they have passed their qualifying examinations; and their research is often conducted in isolation in libraries, archives, or in the field. Consequently, doctoral students in these disciplines do not receive the same amount of academic and social support as their counterparts in the sciences. (Bowen & Rudenstine, 1992; Wilson, 1965).

The description of doctoral education in the disciplines above only characterizes their intellectual and social structural differences in broad strokes. It does not explain how the academic and social interactions that are embedded in and develop out of these structures contribute to attrition. The next section develops the theory of integration and shows how the mechanisms that lead to integration are allocated differently in the different disciplines.

The Mechanisms of Integration

The concepts of academic and social integration (Tinto, 1987, 1993) have been used extensively to explain both undergraduate and graduate student attrition. Lovitts (1997) elaborates on the mechanisms which contribute to each type of integration. Academic integration develops through formal interactions between and among graduate students and faculty as they work together on common tasks to achieve the primary goals of graduate education:

intellectual and professional development. Social integration develops through informal, casual interactions between and among graduate students and faculty outside the classroom. The programmatic, social, and even physical structures of a department can facilitate or impede academic and social integration.

The programmatic structure of a graduate department is related to the structure of the discipline. Some disciplines, like the sciences and laboratory-based social sciences, are structured around research teams. Students and faculty are in almost constant interaction all day long and sometimes late into the night. In such situations, the line between formal academic interaction and informal social interaction becomes blurred. Other disciplines, such as the humanities and nonlaboratory-based social sciences, are structured around individualized research that takes place in isolation in libraries, archives, and the field. Opportunities for social interaction to develop as a consequence of academic tasks is reduced. The differential attrition rate between students in the sciences and students in the humanities is consistent with this contention.

In the graduate school environment, academic and social integration are closely intertwined. Events such as weekly colloquia and brown bag lunches, on- or off-campus social hours, and departmental recreational activities that bring students and faculty into regular, informal contact foster an esprit de corps. Departmental traditions such as holiday parties, picnics, and the like heighten socioemotional integration between and among the graduate students and faculty who participate. How a department's physical space is structured has implications for both types of integration. Graduate lounges provide opportunities for students, as well as faculty who use them, to meet and interact informally. Group, as opposed to individual, offices for graduate students bring students into prolonged and informal contact. The frequent, and, sometimes chance, meetings and social exchanges that take place in hallways, and around mailboxes and coffee pots lead students to develop a sense of community membership.

The extent to which departments provide structures and opportunities for integration and the relationship between department environments for integration, student integration in those environments, and attrition was tested empirically as described below.

Sample and Methods

The sample consisted of nine departments, three in each of

the three major disciplines (sciences: mathematics, chemistry, biology; social sciences: economics, psychology, sociology; humanities: history, English, music) at two universities, Rural and Urban.

Data on the departments' structure and opportunities for integration were obtained through telephone interviews with the Directors of Graduate Study (DGS) and site visits to each department. The interviews explored the existence and nature of the departments' formal and informal academic and social structures and activities for graduate students and for their professional development (see Table 1). During the visits, field notes were taken on the departments' integrative environments. Special efforts were made to observe graduate student offices, to note student-student and faculty-student interactions, and to spend time in graduate student lounges. Data on students' actual integration in their departments came from the survey responses of 816 former doctoral students (511 completers, 305 noncompleters) who were members of the 1982-84 entering cohorts in the departments and universities noted above. This sample was 88% white. No analyses could be done by racial/ethnic group. Rather than asking students if the structure or activity was present in the department, the students were asked if they received or how frequently they participated in the structure or activity.

Table 2 presents this studies' departments' attrition rates by university. Note the large differences in attrition rates between Rural and Urban's economics and sociology departments. The dissimilarity indicates that the cause is not inherent in the discipline.

Department Environments for Integration and Attrition

Using information reported by the DGSs or observed during the site visits, an overall integration score was calculated for each department. The overall scores were subdivided into academic and social integration scores based on the factors depicted in Table 1. When the departments' three integration scores were compared with their attrition rates, two of the correlations achieved significance: overall integration and attrition ($R = -.41$, $p = .044$) and academic integration and attrition ($R = -.54$, $p = .011$). These results suggest that the more conducive the department's environment for integration, academic integration in particular, the lower the department's student attrition rate.

Student Integration in the Department and Attrition

A score for students' integration in each department was calculated by summing individual student responses to the survey questions and obtaining averages for each department. The overall student integration score was subdivided into an academic and social component.

The three student integration scores were compared with their departments' attrition rates. Although none of the correlations achieved significance, the signs of all the correlations were negative, as would be expected if the hypothesis, "The more integrated students are in the department, the lower the department's student attrition rate," were true.

The Relationship Between Department Environments

To assess the relationship between the department environments for integration and actual student integration in the department, the department integration scores were correlated with the student integration scores. The correlation between the academic integration scores achieved significance in the predicted direction ($R = .48$, $p = .021$), indicating that the more opportunities a department has for academic integration, the more academically integrated students become. The correlation between the social integration scores also achieved significance, but not in the predicted direction ($R = -.42$, $p = 0.42$), suggesting that the more opportunities a department has for social integration, the less socially integrated students become.

Discussion and Conclusion

From the evidence provided above, it appears that the intellectual structure of the discipline shapes opportunities for academic and social integration across departments within that discipline by structuring the nature of academic tasks and the frequency of academic interactions as well as the social relationships that develop out of task-related interactions. These differences in structures and opportunities for integration influence the characteristic and stable patterns of attrition that have been observed across disciplines for several decades. It also appears that different departments provide different structures or opportunities for integration and that these structures and opportunities affect student integration and persistence outcomes in a manner that is independent of the parent discipline. These differences in the structures and opportunities for integration help explain the variability in attrition rates among departments within a discipline. The evidence also indicates that persistence outcomes are affected more by opportunities for academic integration than by opportunities

for social integration, as one would predict, because graduate students attend graduate school for academic not social reasons, and, consequently, their degree of integration into the academic systems of the department should, and does, matter more for persistence than their integration into the social systems.

A more extensive elaboration can be found in *Leaving the Ivory Tower: The Causes and Consequences of Departures in Doctoral Study*. Rowman & Little-field, Boulder: Colorado (in press).

References

Benkin, E.M. (1984). Where have all the doctoral students gone? A study of doctoral student attrition at UCLA. (Doctoral dissertation, University of California at Los Angeles, 1984). Dissertation Abstracts International, 45A, 2770.

Berelson, B. (1960). Graduate education in the United States. New York: McGraw-Hill Book Company, Inc.

Bowen, W.G., & Rudenstine, N.L. (1992). In pursuit of the Ph.D. Princeton, NJ: Princeton University Press.

Durkheim, E. (1951). Suicide. (J.A. Spaulding & G. Simpson. Trans.). Glencoe, IL: The Free Press. (Original work published in 1897)

Lovitts, B. E. (1997). Leaving the ivory tower: A sociological analysis of the causes of departure from doctoral study. (Doctoral dissertation, University of Maryland at College Park, 1996). Dissertation Abstracts International, 57A. (University Microfilms International, 9718277).

Tinto, V. (1987). Leaving college: Rethinking the causes and cures of student attrition. Chicago: University of Chicago Press.

Tinto, V. (1993). Leaving college: Rethinking the causes and cures of student attrition (2nd ed.) .Chicago: University of Chicago Press.

Tucker, A. (1964). Factors related to attrition among doctoral students (Cooperative Research Project No. 1146). Washington, DC: U.S. Office of Education.

Wilson, K.M. (1965). Of time and the doctorate: Report of an inquiry into the duration of doctoral study. Atlanta, GA: Southern Regional Education Board.



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An Interview with Dr. Mary Louise Soffa

By Virginia Van Horne, Senior Research Associate

Each issue of Making Strides features a short interview with an underrepresented SME professor who has been instrumental in mentoring and encouraging students through the pipeline, as well as demonstrating leadership and outstanding accomplishments in the world of SME.

This issue I had the opportunity to chat with Dr. Mary Louise Soffa, Professor of Computer Science at the University of Pittsburgh. A 1999 Presidential Awardee Winner for Excellence in Science, Mathematics and Engineering, Dr. Soffa received her B.S. in Mathematics from the University of Pittsburgh in 1962, her M.S. in



Mathematics from Ohio State University in 1967, and her Ph.D. in Computer Science from the University of Pittsburgh in 1977. Having authored or co-authored more than 110 publications, Dr. Soffa's current research projects include A Frame-work for Scalable Flow Analyzers and Optimizers; De-bugging Programming Versions; Compiling for Instruction Level Parallelism; and, Using Artificial Intelligence Plan Generation for Graphical User Interfaces Testing. Dr. Soffa served as the Graduate Dean in Arts and Sciences at the University of Pittsburgh from 1991 through 1996. As Vice President for the Computing Research Association (CRA) and Co-Chair of the CRA's Committee on the Status of Women in Computer Science and Engineering, she is an elected fellow of ACM and serves on several editorial board. She is currently a member-at-large for the ACM SIGBoard. During her tenure at the University of Pittsburgh, she has graduated 18 Ph.D. students (50%

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have been women) and 54 Master's students.

What led you to computer science?

When I grew up, computer science did not exist as a field. My interest in science came from my father. He always emphasized science to our entire family, when we were getting ready to go to school. When studying, he would highlight science and math and stress their importance. I took a lot of math in high school and always did well. Although my dad hadn't gone to college, he saw opportunities in studying science and math.

By the time I was ready for college, my older brother was attending the University of Pittsburgh, majoring in engineering. I knew I would attend the same university--our family lived in Pittsburgh, and it was what we could afford--yet, the only engineering I was interested in was civil. My dad didn't think this was an appropriate field for a woman! Consequently, I went into mathematics and I graduated in 1962 with a B.S. in mathematics.

Tell us about your experience as an undergraduate.

There were few women in my math classes. At times, it was difficult. Realistically, everybody has a story about their experiences. Mine is that I was the only female in my calculus class. On the first day the professor asked all of the students to remain standing as he called out our names. As he called out a name, he'd seat that person in alphabetical order. He skipped over my name and eventually, I was the only person standing. When I asked him where I should sit, he responded that I could sit anywhere since girls didn't belong in this class. At that moment, I told myself that I would get an A in his class; and I did. I worked very hard, and received assistance from the professor. In fact, I graduated Phi Beta Kappa from the University of Pittsburgh with a 3.9 grade point average.

Back then, I was extremely shy and never spoke in class; people cannot believe this now. Because I was completely intimidated by faculty, I never talked to them about graduate school. Nor, did a faculty member ever approach me to discuss graduate school. It is for this very reason that I approach good students; they may feel uncomfortable about approaching me.

What did you do upon graduating with a B.S.?

My husband and I met in college. He graduated with an engineering degree and went to graduate school at

Rensselaer Polytechnic Institute. I applied to General Electric and got a job at their research lab in Schenectady, New York. Some of my work for GE involved programming. (That was about the time that computer programming started.) Although the programming was interesting, it was my other role, as a "calculator," that I found discouraging. One of the GE scientists regarded me as his personal "calculator." If I made one error, he became furious. His behavior toward me was impossible. I knew that this was not my life's work.

After a year at GE, with encouragement from my husband, I decided to go to graduate school and get a Master's degree in math.

What led you to Ohio State?

My husband went to Ohio State to complete his doctorate work. During this time, I gave birth to a baby girl, Melanie, in 1963. When she was only four months old, I entered the Master's program at Ohio State. I feel it is important to discuss this. From all of my work in this field, and from talking with so many women, I know, firsthand, that having a child and going to graduate school is a major concern. Many women want to know: how can I do this and have a family? You have to continually impress upon them that it IS possible. My husband would come home and take care of Melanie while I was in school. Sometimes, a next door neighbor would come over and babysit.

What led you to return to the University of Pittsburgh?

I got my Master's degree in 1967. My husband was offered a faculty position at the University of Pittsburgh so we returned there and in 1968 I gave birth to another child, Tracy. Shortly thereafter, I enrolled in the Ph.D. program in mathematics at the university. I was very fortunate because my mother lived nearby and she was able to help with the children. And, as a professor, my husband was able to help quite a bit.

I was in the mathematics program for about one-and-one-half years and was feeling that the work I was doing (pure mathematics) wasn't particularly relevant to what was going on in society at that time. Tremendous social and political changes were occurring, and I wanted to do something that could help others. I decided to leave the math department and entered the sociology department in 1969. I had a fellowship in that department and stayed for one year. I realized that sociology wasn't for me; perhaps because it was so different from mathematics.

In 1970 I went into the graduate school of public health, studying environmental acoustics (noise pollution). While at the school of public health, I began taking some computer science classes. Within a year, I realized that computer science was my true passion. Consequently, I entered the computer science department in 1972 and received my Ph.D. in 1977.

Was it difficult making these study field transitions?

I had no mentors along the way. I did well in my classes. It was never a problem to get into another program, and I always had a fellowship. People did question me as I left each field, but I had a good reason--I was looking for my life's work!

And, then?

I knew I needed to work at a place fairly close to our home. I applied for several positions and received an offer from the University of Pittsburgh in 1977 and I have been here ever since. It so happened that my advisor was leaving the university at the same time that I was looking for a position.

Why academia?

I enjoy doing research and the academic environment. It never occurred to me to go into industry. This was my life's work. I knew this when I was in graduate school.

Tell us about your career at the University.

For the first 14 years, I was the only female in the department whose size ranged from 12 faculty in 1973 to 20 now. At one point four of the 20 were women; now there are only two. But, there are few women in this field. And, I'm unsure if the university environment is attracting women to faculty positions. The women we've had have left for better opportunities or due to a "two body" problem (two professional people looking for positions). I got tenure in 1983 and was promoted to full professor in 1990. I also served as the graduate dean in arts and sciences from 1991 to 1996. Can you elaborate on your role as a graduate dean?

As graduate dean, I continued my research, but didn't continue teaching. I had several goals, and one of them was to increase the number of women and underrepresented minorities in the graduate programs. I instituted a number of programs; e.g., I found fellowship money and I gave fellowships to any department who could attract an underrepresented minority. I would fund that student for

two years. The department had to provide a faculty mentor for the student and update me periodically on that student's progress. The department was also obligated to provide funding for that student until their Ph.D. was completed. Because of this initiative, over a four-year period, I increased the number of underrepresented minorities in math and science graduate programs by 100% (from 10 to 20). This program is still in place!

Although I enjoyed parts of the job, in particular, making an impact in terms of minorities, I knew that computer science was a field that moves very quickly and that I had to go back and continue my research or give it up. It was difficult to do research and be a full-time dean. In 1996 I decided to return to a faculty position and do research.

Were you surprised to win the Presidential Award for Excellence in Science, Mathematical, and Engineering Mentoring?

I received this award in 1999. I was truly honored just to be nominated, let alone win an award! One of my previous graduate students was the nominator and other students wrote support letters. I was thrilled that they thought enough of me to do this. Do you see students leaving the field of computer science?

At the university level, there's a real concern in the field of computer science about the numbers of people leaving the university because it's so easy to get well-paying jobs. Some students leave before getting their B.S., especially if they go on internships. The students become involved in the companies and don't come back. As a discipline, we're having problems getting students--especially American students--to go onto graduate schools. Many of the students in this field are foreign. In our department, 65% of the graduate students are international.

Those who do get their Master's don't want to stay to get their Ph.D. It really is a crisis situation. The thing about computer science is that there's a lot of research being done in industry. The research is very similar to what's being done in the university. It's not necessarily true that better research is being done in the university, however, at the university you have more control over the research you do. And, you can impact students.

Tell us about your students.

I teach undergraduates and graduates and also do research in programming languages and software engineering. So

far, I've graduated about 18 Ph.D. students (50% have been women) and 54 Master's students. Currently I have three Ph.D. students--one Hispanic female and two international males. The female is graduating this summer and taking a faculty position at another institution. I also have three undergraduate students working on research with me. I just started this. In the past I've had so many graduate students that I didn't have time to mentor the undergraduates. Now, since the numbers are going down, I have more time.

I try to mentor and encourage all of my students. Frankly, I want them to go into universities and also be mentors.

We have a long way to go to make this an inclusive field. There are still challenges in terms of feeling isolated. If you are female or a minority, there's a sense of isolation. There aren't many of us. Having confidence in yourself is important. It's one of the most important things I have to do with students: encourage them, help them build their confidence, make sure they have successes along the way.

Thank you, Dr. Soffa.

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**A Profile of an AGEP Institution:
University of Puerto Rico**

*By Brad Weiner, Dean of the College of Natural Sciences,
Rio Piedras Campus, University of Puerto Rico*



The University of Puerto Rico has a strong tradition of and commitment to providing an outstanding education and graduating well-prepared students. The University of Puerto Rico System (UPR), comprised of a total of eleven units--three

graduate campuses and eight four-year colleges--is one of the premier Hispanic Serving Institutions. It produces more underrepresented minority Ph.D.s across all fields than any other institution in the nation. Serving as the baccalaureate-source institution for close to twenty percent of all science, mathematics, engineering and technology (SMET) doctoral degrees conferred to Hispanics nationwide, UPR is also a major source of minority Ph.D.s at other universities. Currently classified as a Doctoral University by the Carnegie Foundation for the Advancement of Teaching, UPR is committed to continuing to be a strong teaching institution and to becoming an outstanding Research University in the next two years. The University of Puerto Rico Alliance for Graduate Education and the Professorate (UPR-AGEP) is a five-year National Science Foundation funded project whose goal is to achieve at least a one-hundred percent increase in the total SMET Ph.D.s conferred at the Río Piedras and Mayaguez campuses of the University of Puerto Rico.

The Ph.D. programs in the UPR-AGEP project--Chemistry, Biology, Chemical Physics, Civil Engineering, and Marine Sciences--determined that the primary factors responsible for low Ph.D. graduation rates were recruitment and retention. As a result, the AGEP program is designed to

Program. Its purpose is to share information about minority graduate education in the fields of science, mathematics, and engineering. It is available in print and electronic format. Inquiries, information related to AGEP, and all correspondence should be sent to the editor.

promote a systematic, proactive, and concerted institutional effort to recruit students and provide a coherent continuum of support not only to assist them in the initial transition into doctorate programs but also through the critical stages of the programs. The implementation of the AGEP project required a transformation in the organizational culture of our Ph.D. programs to provide special focus on student recruitment, student support, and the preparation of teaching assistants.

UPR-AGEP includes the following components:

Recruitment and Entry into Ph.D. Programs

Teams of faculty and students from each participating Ph.D. program visit institutions around the island to discuss with undergraduate students opportunities for doctoral studies and careers in the fields of science, mathematics, engineering, and technology. Faculty members also disseminate AGEP and program information at national conferences and visit universities with high concentrations of Hispanic students. Fifteen full fellowships that include funds for stipends, tuition, and travel are an important facet of the recruitment strategy, with travel funds also assisting in preparing students to be professionals.

Facilitating Transition and Retention Bridging Seminars

All incoming graduate students participate in Summer Bridging Seminars and follow-up activities during their first year of studies. In the summer seminars students elaborate graduate study and career plans, visit research laboratories, and become familiar with basic academic services (e.g. library, computer center) and non-academic services (e.g. housing, cultural activities and information, sports, medical and counseling services).

Graduate Student Peer-Mentors

To promote retention and enhance students' skills in those areas required of professionals, students who have completed their second year serve as peer-mentors. Peer-mentors learn effective mentoring strategies, are matched up on a one-on-one basis with incoming students, and assist them with issues ranging from juggling time and schedules to improving communication, reasoning, and study skills. Both the peer-mentors and new students have high praise for this facet of AGEP, pointing out that student-to-student communication is not threatening, that students are freer to communicate certain kinds of information or insights than faculty, and that peer-mentors gain experience, skills, and insights that will assist them in their careers. This component of the AGEP project is one of the most successful. Enhancing Teaching Assistant Training To

improve and broaden the teaching skills of TAs and increase the number of Ph.D. students selecting careers in academia, students work with faculty members from the respective departments in an intensive two-week summer seminar. Faculty and students focus on new paradigms of teaching/learning, address issues related to developing, grading, and returning assignments in a timely manner, and practice formal and informal teaching/learning techniques.

Increasing Scholarly Productivity

During the academic year, second and third year graduate students participate in seminars and workshops designed to enhance their potential as professionals and members of the academic community. Workshops include such topics as developing and making scientific presentations, grantsmanship, and forming networks. Although UPR-AGEP has been in place only two years, the impact is clear, and two new graduate programs, Mathematics and Chemical Engineering, are being integrated into the project. Enrollment in graduate programs is up, but more importantly, the ratio of Ph.D. to master's degree students has increased. There is some evidence that students are fulfilling course and other requirements more quickly than students in the past, and the average number of Ph.D. graduates per year has increased from 13 to 20. AGEP supports the UPR tradition of being an outstanding teaching institution and assists in its transition to being an outstanding teaching and research institution.