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Author

Maclachlan, Anne

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ANNE J. MACLACHLAN
CENTER FOR STUDIES IN HIGHER EDUCATION, UC BERKELEY

*A Longitudinal Study of Minority Ph.D.s from 1980-1990:
Progress and Outcomes in Science and Engineering at the
University of California during Graduate School and Professional Life*

FOCUS OF THE RESEARCH

The study is framed by two questions:

1. What contributed to the successful completion of a Science, Technology, Engineering, and Mathematics (STEM) Ph.D. by minority graduate students at the University of California between 1980 and 1990?
2. Did their subsequent careers after the Ph.D. correspond to their training and aspirations?

Answering these questions entailed learning about participants' entire lives from birth to the present, and studying individuals of all ethnic groups to look for similarities and differences in background, experiences, educational path, and careers. 158 Ph.D.s were interviewed: 33 African Americans, 35 Asian Americans, 24 Chicanos, 13 Hispanics, 5 Native Americans, 52 European Americans. The latter were matched to minority students from the same lab, with the same advisor, and similar degree year. Interviews averaged between two and three hours and used a standard questionnaire.

FINDINGS

I. Life before graduate school

1. Family support and stability contributed substantially to student success without respect to parents' educational level. Almost all study participants had both parents present when in elementary and secondary school.
2. Asian Americans had the most educated parents: 60% hold at least one college degree; Chicanos had the least educated parents: 70% hold a high school diploma or less.
3. For many study participants from poor families with relatively uneducated parents, intervention by a teacher, school counselor, or neighbor was decisive in either putting or retaining the pupil on track for academic achievement.
4. Teachers and school counselors were critical to putting these pupils on the college track by informing them about what it meant to go to college, taking them to college campuses, or recommending them for summer science programs, and directing them to financial aid.
5. While in secondary school, members of all ethnic groups participated in honors classes, special science programs, or graduated valedictorian at roughly the same rate.
6. Once in college usually other than research universities, around 50% of African American, Chicano, and white students participated in scientific research through summer programs, paid employment, or in special courses. An advanced degree in science became their goal, often replacing the goal of an M.D. degree.
7. Only 9 students from all ethnic groups graduated with an overall G.P.A. under 3.0; 8 of these completed Master's degrees before applying to a doctoral program.

II. *Life in Graduate School*

1. Study participants entered graduate programs with very different educational backgrounds: 93% of Asian American students came to the University of California (UC) from Research Institutions, while only 58% Chicanos, and 46% Blacks did. African Americans who had attended HBCUs had a difficult time adjusting to a large and impersonal white place like UC Berkeley.
2. Twenty-seven of 158 graduates (17%) reported not understanding graduate school expectations in their first year and beyond.
3. Members of all ethnic groups usually rated themselves as equal or good to very good in comparison with other members of their first year cohort, but in every group was a minority who thought they were inadequately prepared, did not have a research topic, or felt themselves inadequate in other ways.
4. Yet, students of all ethnic groups succeeded in their first year through their own diligence, drawing on an existing personal support systems, or creating such a system at their UC with peers and faculty.
5. Academic problems were experienced by a limited number of graduates of all ethnic groups and at different times through the Ph.D. program.
6. Fellowships provided by affirmative action status substantially assisted in timely and successful degree completion for the recipients.
7. Prestigious fellowships (NSF, NIH, Ford, IBM) were held by similar percentages of every ethnic group.
8. While most former students gave their dissertation advisors a high rating overall, the same advisors were found deficient in professional development training: especially in grant writing and in helping advisees learn to teach, write articles, network, and present papers.
9. Racism was a daily experience of most African Americans in the study, despite their academic success. Racism was experienced less by Chicanos, but Chicanas and Hispanic women experienced both racism and sexism from time to time. Sexism was also experienced by some white and Asian women. Fellow students were more likely to engage in such behaviors than faculty, although a few faculty were considered strongly racist.
10. Success in graduate school was attributed generally to a combination of great support from family, spouses or friends, a passion for science, an appreciation one's own competence, developing a positive relationship with at least one faculty member, and a clear plan about getting through graduate school.

III. *Life After Graduate School*

1. Postdoctoral positions lasting from 1 to 6 years were held by 92 (58%) new Ph.D.s primarily in the life sciences and chemistry. Due to an absence of advising, some of these positions were inappropriate, but the majority were successful in launching careers.
2. Forty-one of the 158 (26%) never worked in an academic position and are now industrial researchers, entrepreneurs, government researchers / administrators, lawyers, or non-profit employees.
3. The majority (98, or 62%) are professors teaching at a spectrum of institutions including many research universities. Their reasons for selecting a particular college or university position are

complex: the ability to continue to do good science is major, but serving one's community (7 teach at an HBCU), promoting diversity and supporting first generation students, geographical location, and having time for family life are also factors in the decision. Most are reasonably satisfied with their current positions, although a small number needed several job changes to find a compatible position.

4. A large number (31, or 20%) of study participants made career choices which enabled them to stay in the San Francisco Bay Area.

5. Almost all in the study believe their careers correspond to their training and aspirations. The exceptions accept that it was their own decision to, say, turn down employment at a research university or stay in a particular area for family or community reasons. A few have had a very difficult time before arriving at their present positions.

6. But in terms of what each wants from life, almost all consider themselves successful.

7. Overt racism was uncommon in the careers of the minority scientists, but a pervasive sense of being judged differently or having to work harder than whites persists for many. Because of the ineffability of racism, a large number feel that it could have affected their careers, but are not certain.

IMPORTANCE OF THE FINDINGS

This is the first study of the lives of Ph.D. scientists and engineers of many ethnicities educated at the same time, in the same type of university and based on systematically collected autobiographical data directly from the participants. It is also a collective biography of a particular generation successfully making its way through the educational system at the time of the Civil Rights Movement. It gives voice to the particular experience of each participant and records their own view of their life.

It is also the first study to focus on the success of ethnic minorities in STEM graduate programs and careers and to document experience in such a way that both deficits and benefits of graduate education are apparent. Some graduate school experiences are a sharp indictment of the system. But nearly all of the interviewees' experiences suggest that graduate education is inefficient in transmitting skills necessary for professional development, and too often idiosyncratic and unreliable in terms of mentoring and career advising. A longer time to degree is a result. At the end few were disappointed with the intellectual content of their programs, but many were with the structure in which it was transmitted. Extensive advice for new graduate students from the study participants is provided along with their recommendations for reforming graduate education. This study also contributes detailed knowledge about career paths in science and how they have been shaped.

When published as a book, it is meant to be broadly read by college students, particularly students of color, as a means of inspiring them to pursue a professional career by seeing how others like them have done it. It is also a book to be read by science and engineering faculty and graduate school deans to learn about issues of graduate education that are in their power to fix. Finally this is a book for specialists of diversity and higher education as it shows how higher education could be made more inclusive and more effective.

FUTURE RESEARCH

This study has been my major focus for many years. The richness of the material has enabled me to write separate articles on aspects of the population under study. Quite a number of study participants attended community college, and it is now emerging that for a great many first generation students, the community college begins the pathway to the doctorate in STEM.

Emerging from this is my next study on how URM students start to take the classes in a Californian community college (CCC) which will enable them to transfer to a four year institution. Who is served by remedial math classes at a community college and does completion of such courses put students on the science track? Why are only 15 CCCs responsible for the majority of transfer students to CSU and UC in STEM, and why are there so few URMs among these transfers? Given the diversity of the State and the overwhelming contribution of STEM degrees to scientific workforce development, California must make its postsecondary system accessible to students of all backgrounds and in relation to the distribution of ethnicities in the population. This is my future focus.

CHANGES IN PLANS

After obtaining more detailed data on URM Ph.D. recipients granted from UC between 1980 and 1990, the number of URM students dropped from 415 to 221 once “Hispanics” were excluded as an “underrepresented” population. After great initial success in both finding and interviewing individuals in the study, the process for both became very time consuming, and once found, several people refused to be interviewed.

We also revised the questionnaire to capture greater detail generally and more information about participants’ family, so we re-interviewed around 30 people asking them only the new questions. All of this substantially extended the time required to conduct interviews and extended the project time from 2 to 4 years, and diverted funding for travel and publication to personnel. Since most of those who were found were from one campus, UC Berkeley, it made no sense to compare whether specific campuses affected student experience during graduate school. The distribution of fields was heavily skewed toward biology and chemistry with few in physics or engineering of any kind. This did not allow for an effective comparison of graduate experience of disciplinary culture. Otherwise, we accomplished most of what we set out to do and a great deal more in other areas.

LIST OF PUBLICATIONS

“The Graduate Experience of Women in SMET Fields and How it Could be Improved.” In Jill M. Bystydzienski and Sharon M. Bird, eds., *Removing Barriers: Women in Academic Science, Technology, Engineering, and Mathematics*. University of Indiana Press, 2006

“Developing Graduate Students of Color for the Professoriat in Science, Technology, Engineering and Mathematics (STEM).” *Keeping Our Faculties of Color Conference*, 11/04. http://www.cce.umn.edu/kof/cdrom/pdfs/KOF007_DevNextGen_MacLachlan_A.pdf

“Research on Addressing Institutional Challenges in Science and Engineering to Increase Faculty of Color.” Plenary Panel Address, *Keeping our Faculties of Color Conference*, U. of Minnesota, November 18, 2004. Available:
http://www.cce.umn.edu/pdfs/CPE/KOF/Anne_MacLachlan_Paper.pdf

“Why be a Professor? The Experience of Underrepresented STEM Ph.D.s Earned from the University of California between 1980-1990.” *AAAS Annual Meeting*, Seattle, February 15, 2004

“Career Choices, Promotion and Retention of Ph.D. Women Scientists in the Scientific Workforce.” For the *12th International Conference of Women Engineers and Scientists: Women in a Knowledge Based Society*. Ottawa, Ontario, July 27-31, 2002. Published in Conference Proceedings, November 2002

“Gender in the Career Paths of Ph.D. Women Scientists in the Scientific Workforce.” *Women and Research Conference*, European Directorate for Research, Brussels. November 8-9, 2001. In Linda Maxwell, Karen Slavin, Kerry Young, eds. *Gender and Research*. Brussels: European Commission, 11, 2002

“Against the Odds: How Minority Women Scientists Negotiate the Workplace.” In *Making Strides*, AAAS, July 2001

“The Lives and Careers of Minority Women Scientists.” For *The 3th Annual International Conference, Women in Higher Education*, organized by NAWA, New Orleans, January 8-11, 2000, paper published on own website: <http://cshe.berkeley.edu/>