Education and Human Resources at the National Science Foundation

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IT IS NOW WIDELY UNDERSTOOD THAT THE NATION FACES A serious problem in science and engineering education and that we are not mobilizing the human resources we need to compete effectively in the modern world. We know that:

- Our high schools offer too few science and mathematics courses. Those that we do have are of uncertain quality and taught by inadequately supported teachers to too few students. Not surprisingly, one result is that Americans routinely place toward the bottom of the list in international comparisons of student achievement.
- Student interest in science and engineering is declining. Only about 15% of college freshmen plan a major in science or engineering. The number of baccalaureates in these fields is declining, and a demographic decline in the number of college-age students will make the problem worse for most of the 1990s.
- At the end of the pipeline, too few new PhDs are being produced, and an increasing fraction—over 50% in engineering and mathematics—are foreign students. A recent report of the National Academy of Sciences concludes that in areas dependent on mathematics, the demand for engineers, scientists, and technicians is growing about twice as fast as supply and will exceed supply by 35% in the year 2000. And that is not far off—almost everyone who will have a PhD by 2000 is already in college.
- Finally, we have made little progress in bringing women and minorities into science and engineering. Yet minorities are 30% of the student population today, and will be about 40% by 2000. Together with women, these are the groups in which we must find increasing numbers of our future scientists and engineers.

It still surprises some researchers with long relationships with the National Science Foundation to learn that any of this matters to NSF. But, in fact, under the National Science Foundation Act of 1950, education shares equal billing with research as a core mission of the foundation. The foundation has this mission because Congress believes that (i) NSF is the agency most directly concerned with maintaining the flow of graduate students in science and engineering; (ii) NSF can make the connection between researchers and educators in science and engineering better than any other federal agency; and (iii) NSF can lead in such areas as research in education, curriculum development, and teacher training—all areas in which the decentralized efforts of the states and local school systems are inherently less effective. And although there has been wide variation in the level of effort devoted to it, education has been a principal activity of NSF for most its history.

From 1951 to 1970, during the first half of the foundation's existence, the proportion of the NSF budget devoted to education fluctuated around 30%, the high being 46% in 1959. After 1971, education's share dropped rapidly to about 8% in the late 1970s, hitting bottom at about 2% in 1982–83. In 1982 the Directorate for Science Education was abolished, and for a brief period NSF ceased to play a major role in education. But the recovery turned out to be as rapid as the decline. Today the foundation spends about 20% of its budget on education and related human resources development programs, and the proportion is growing as we continue to realize our needs for people with technical qualifications.

During the 1980s the problem of education and human resources in the technical fields moved from being the obscure concern of a few specialists to a matter of high national policy, its status symbolized by the President's goal of making our students "first in the world in science and mathematics achievement" by the end of the century. The NSF has both led and reflected this developing national consciousness. In 1982, as education funding hit its all time low, the National Science Board established a special Commission on Pre-College Education whose report, *Educating Americans for the 21st Century*, effectively marked the rebirth of the education mission at NSF.

This first report was followed in 1986 by a second major effort, under National Science Board Member Homer Neal's leadership, that did for undergraduate education what the earlier report did for precollege education. These reports were landmarks that confirmed NSF's commitment to creating effective programs to improve American education in science, mathematics, and engineering.

At the same time, the scientific community has become more concerned about the waste of human resources, especially among women and minorities, resulting from our failure to provide educational experiences that draw more of these students into science and engineering. With women and minority groups making up an increasing part of our work force, it became apparent that we could not (and should not) rely any longer on white men, the traditional pool from which scientists and engineers have been drawn, to meet the nation's needs. In addition to earlier concerns with the inequity of having too few women and minorities in technical careers, our concerns today are driven also by the hard reality of meeting the needs of academia, industry, and government for more people.

At NSF, funding for education and human resources has been growing rapidly, to a requested level of $463 million in 1991, more than 20% of the total NSF budget request. This growth has been much faster than in the research area, reflecting in part the smaller base of education and human resource programs but also the high priority placed on these programs by the foundation, the National Science Board, the Administration, and Congress. In 1991, for instance, the requested increase for these programs is nearly 30%, compared with 11% for the research programs.

This rapid growth in funding for education and human resources is supported by explicit long-range planning. The NSF Strategic Plan for 1990–94 lays out challenging objectives: (i) raising the level of excellence and standards of student performance in science, mathematics, and engineering education at all levels; (ii) developing new curricula and course materials so that teachers and administrators have choices available to meet their needs; (iii) raising the qualifications of precollege teaching faculty; (iv) stimulating interest in science and mathematics among female and minority students; (v) increasing the numbers of university faculty concerned with precollege education, and (vi) increasing the numbers of graduate students.

In all of these areas, NSF is either developing new programs or

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strengthening existing ones. In the precollege area, NSF operates eleven programs, which support projects such as a summer institute for mathematics teachers at Fermilab, the annual Presidential Awards in Science and Mathematics Teaching, cooperative efforts by publishers, school systems, and academic teams to develop improved curricula, and projects that bring high-ability junior high school students into direct contact with university and industry scientists. At the undergraduate level, there are programs devoted to providing better teaching laboratories, opportunities for faculty improvement, and better curricula. At the graduate level the focus is on fellowship programs, including a special effort aimed at minorities, and on postdoctoral grants and Presidential Young Investigator awards for beginning researchers. All of these areas are scheduled for substantial increases in the 1991 budget request now before Congress, with the greatest emphasis on improvements at the undergraduate level. Future increases will span all levels, however, for many promising students are lost to science and engineering in junior high school and at every level thereafter.

Reorganization at NSF is part of this growth and change. For many years, NSF has had an "education" directorate and several "research" directorates. In recent years, however, the research directorates have had significant roles in education, especially at the undergraduate level. The human resources programs have also developed mainly outside of the education directorate. Recently, however, we moved to increase the linkages between research and education and to strengthen the management of education and human resources programs throughout the foundation. A new Directorate for Education and Human Resources (EHR) has been created, in order to include all the programs of the previous Science and Engineering Education Directorate plus other activities explicitly devoted to human resources. The new assistant director for EHR is also responsible for planning and coordinating all education and human resource activities located elsewhere in NSF.

The new assistant director is Luther Williams, former vice president of the University of Colorado and president of Atlanta University. One of his major activities will be to improve coordination of the federal effort in EHR. For the past year, he has been the key person at NSF concerned with this coordination. He is vice chairman of the Federal Coordinating Committee on Education and Human Resources, and currently leads a working group planning the overall federal effort in science and engineering education and human resources. Under his leadership we have already developed significant new areas of cooperation with the Departments of Education and Energy.

By any measure, the federal government is closer to a coordinated effort to mobilize and educate our people in science and engineering than we have ever been. At NSF, we are now poised to be more effective in providing national leadership in education and human resources than ever before. The commitment is there, at all levels of the foundation, and it is supported by a commitment in the Administration, other agencies, and Congress. Resources are being made available, even in this period of extremely tight budgets.

Despite all this activity, however, no one believes that NSF, or even the federal government as a whole, can change American education by itself. Our system of education is diffused, with responsibility divided among the states and local governments, and public and private institutions, as well as the federal government. Industry is also getting involved as companies find that they must play an active role in order to get people to fill technical positions. A cooperative effort involving all these players and the students, parents, teachers, and others directly involved will be necessary to really solve the problem.

NSF can, however, offer the crucial leadership and stimulation that will bring other players to the table to deal forcefully with the problem. As the states, industry, and local institutions also begin to move, we should see significant change and a good start on achieving the President's goal of being best in science and mathematics.