

Section II:

Program History of Undergraduate Activities at NSF Since the Neal Report (86-100)

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As was noted in *Shaping the Future: New Expectations for Undergraduate Education in Science, Mathematics, Engineering, and Technology* (NSF 96-139), the report of the 1985-1986 Task Committee of the National Science Board (86-100) has been the principal guide for the restoration and evolution of NSF undergraduate education activities since its acceptance by the Board in March, 1986. Presented in this section is more detailed analysis of some aspects of the Foundation's efforts to implement the 1986 report in the decade since. Small portions of text from Volume 1 of *Shaping the Future* are repeated here to aid the reader in recalling the framework.

The numerous recommendations in the Board Report fell into two categories: *Leadership* and *Leveraged Program Support*.

Leadership

The *central leadership recommendation* of the National Science Board Task Committee was that the Foundation

"Develop quickly an appropriate administrative structure and mechanisms for the implementation of these recommendations. The focal point should be the [Education Directorate]; it should foster collaboration among all parts of the Foundation to achieve excellence in science, mathematics, and engineering education."

The Foundation established such a unit later in 1986. It has evolved into the present Division of Undergraduate Education (DUE) in the Directorate for Education and Human Resources (EHR). DUE staff of program officers is drawn from across the disciplines of science, mathematics, engineering, and technology. Many come from leadership positions in national organizations and from university faculties and administrations. Its programmatic offerings devote attention to the development and dissemination of innovative courses, curricula, and laboratories, as well as to the preparation and development of faculty, future preK-12 teachers, and technicians. Particular emphasis is placed on the translation of innovations among and between disciplines.

The Board Task Committee made 11 other leadership recommendations to the Foundation. It urged NSF to:

"(1) Take bold steps to establish itself in a position of leadership to advance and maintain the quality of undergraduate education in engineering, mathematics, and the sciences."

NSF has clearly established the desired leadership position of the Foundation. Allocations of resources have been smaller than envisioned originally by the Board in some areas, but a little larger in others.

"(2) Stimulate the states and the components of the private sector to increase their investments in the improvement of undergraduate science, engineering, and mathematics education."

Beginning in 1980 with the *Experimental Program to Stimulate Competitive Research* (EPSCoR) and culminating with the establishment of the *Rural Systemic Initiatives* (RSI) program in 1997, the Foundation has fostered the creation of vigorous partnerships involving itself, individual states, and various private sector entities in substantial projects to improve research and education in mathematics, engineering, science, and technology. The emphasis has been on graduate and K-12 education, but articulation of school and college-level programming has been addressed by many of these projects. The partnership mode of project operation ranges in scope from adherence to matching funds requirements to the basing of projects in consortia and collaboratives. Examples of current undergraduate programs are the *Alliances for Minority Participation* and *Advanced Technological Education*.

"(3) *Provide a forum for consideration of current issues related to such efforts.*"

NSF has gone far beyond this directive by sponsoring workshops, symposia, and conferences on disciplinary, cross-disciplinary, and institutional aspects of undergraduate education. The reports of these gatherings circulate widely and are highly regarded resource documents.

"(4) *Implement new programs and expand existing ones for the ultimate benefit of students in all types of institutions.*"

It was apparent to NSF from the start that the emphasis in this recommendation lay in the words *all types of institutions*. Doctoral universities submitted the great majority of successful education proposals in 1985-1986; but by 1994, special efforts by NSF resulted in their number being at least matched by proposals from two-year colleges, four-year colleges, and comprehensive universities. NSF supports the development of a broad spectrum of educational products (from innovative texts and software to new courses and curricula) has helped expand and improve student learning nationwide.

"(5) *Actuate cooperative projects among two-year and four-year colleges and universities to improve their educational efficiency and effectiveness.*"

The principal concern in this area in 1986 was particularly the Advanced Technological Education program, for improved articulation between two-year and four-year institutions. While NSF programs have recently fostered the establishment of consortia and other types of cooperative projects, they have long addressed broader objectives by including two-year college faculty and institutions in the full range of undergraduate programs.

"(6) *Stimulate and support a variety of efforts to improve public understanding of science and technology.*"

NSF has strong commitments to K-12 and informal science education evidence direct concern for public understanding. It is hoped that activities following upon the recommendations of this report will enhance efforts to address similar needs at the undergraduate level.

"(7) *Stimulate creative and productive activity in teaching and learning (and (8) conduct research on them), just as it does in basic disciplinary research. New funding will be required, but intrinsic cost differences are such that this result can be obtained with a smaller investment than is presently being made in basic research.*"

The next section examines in detail the funding history of undergraduate activities at NSF. However, it is the case that the Division of Undergraduate Education allocates most of its resources quite directly to activities designed to improve teaching and learning. The Division of Engineering Education and Centers in the Directorate for Engineering and the Division of Experimental and Integrative Activities within the Directorate for Computer and Information Science and Engineering devote substantial portions of their budgets to undergraduate engineering education. Across the Foundation it is the scale

rather than the scope which needs expanding. Although EHR Division of Research, Evaluation, and Communication vigorously supports research on teaching and learning, a special effort within this division, as well as those previously mentioned, should be made to stimulate proposals for research on teaching and learning at the collegiate level.

"(9) Bring its programming in the undergraduate education area into balance with its activities in the pre-college and graduate areas as quickly as possible."

The *balance* sought by the Board Task Group was dual—programmatic *and* fiscal. Between FY 1983 (when K-12 education was re-established at NSF) and FY 1986 (when the Board Committee made its recommendations), the main themes of NSF K-12 programs had become firmly established. While urging the restoration of a vigorous undergraduate program, the Committee wanted to ensure that it would be coordinated well with the Foundation's activities at the K-12 level (which produced undergraduate students and employed graduated teachers) and at the graduate level (where the products of undergraduate institutions are further educated).

NSF undergraduate programming in the Education Directorate was brought into that balance by three events: transfer of responsibility for Teacher Preparation from the Division of Elementary, Secondary, and Informal Education (ESIE) to DUE in 1993; establishment of the program in Advanced Technological Education in 1994; and start-up of the Institution-Wide Reform initiative, begun in 1995.

"(10) Expand its efforts to increase the participation of women, minorities, and the physically handicapped in professional science, mathematics, and engineering."

The Foundation as a whole has a good record of such efforts, and the record of the Directorate for Education and Human Resources (EHR) is especially good. In FY 1995, NSF allocated more than 3 percent of its budget to programs, in both the education and research directorates, designed to address underrepresentation. While all divisions of EHR share responsibility for addressing NSF educational objectives in this area, the Division of Human Resource Development (HRD) has the programmatic lead and has mounted a variety of programs designed to increase participation of women, minorities and persons with disabilities.

"(11) Design and implement an appropriate database activity concerning the qualitative and quantitative aspects of undergraduate education in mathematics, engineering, and the sciences to ensure flexibility in its response to changing national and disciplinary needs."

NSF Division of Science Resources Studies has principal responsibility for such database activity. At the present time, some of the Undergraduate Science, Mathematics, Engineering, and Technology (SME&T) Education Database content envisioned by the Board Committee is being built into the *Impact Database* of EHR's Division of Research, Evaluation, and Communication.

Leveraged Program Support

The FY 1995 NSF budget provided a very substantial sum for support of all but one (Information for Long-Range Planning) of the program categories detailed in the Neal Report. The total was actually in excess of the amount recommended for FY 1989 by the Report of the NSB Task Committee. In addition, NSF undergraduate support in FY1995 included programs in categories not mentioned in the Neal Report (*Teacher Preparation and Advanced Technological Education*). How well NSF has done by the Neal recommendations is a judgement that should reflect ten years of experience and hindsight; and it should be informed by comparison with the intent of the recommendations.

