

Challenges for Science Education

Science education in the 1960's, especially at the elementary and secondary levels, was dominated by post-Sputnik science curriculum projects. These projects can be characterized as discipline oriented and content centered with an inquiry approach. Science educators, with government financial support, had adopted a policy to produce a group of highly knowledgeable and highly trained scientists, and had decided to begin this training as early as in the elementary grades.

As we move into the 1970's, curriculum developers, scientists, and science educators and, indeed, the lay person, are questioning some of the emphases of science education in the 1960's. We have left the post-Sputnik era. We are concerned not only with the advancement of technology but also with the assessment of technology; we are concerned not only with increasing the body of scientific knowledge but also with the application of science and technology to societal problems. The science curriculum projects of the 1970's must reflect these additional concerns.

Baez (1) states that the most pressing societal problems of our day can be included, either directly or indirectly, under one of the four P's: population, pollution, poverty, and the pursuit of peace. The advancements of science and technology, which have contributed to the evolution of these problems, now must be used for their solution. One of the challenges of science education, then, is to train scientists and technologists capable of attacking these complex problems.

Because science and technology are such powerful forces, "their importance must be appreciated by all people of the future, not just by the future scientists and technologists. That presents a [second] challenge to science education, namely, the creation of a new generation of people who will understand the power, the responsibility, and the limitations of science" (1).

Training future scientists and technologists capable of analyzing and confronting these problems demands major changes in the discipline-oriented

curricula now being used. Science education, indeed all education, must develop in the students both an awareness of the difficulties facing our society and the capability to contribute toward their solution.

A curriculum attempting to accomplish these ends must be multidisciplinary and must concentrate on developing problem-solving capabilities. This problem-solving capability is more difficult to achieve, and therefore more difficult to teach, than the disciplinary subject material which is now the basis of most educational curricula. The objectives of a multidisciplinary, problem-solving curriculum are much harder to delineate than those of a disciplinary one. Nonetheless, the difficulty must not be a deterrent, for society's ability to effectively solve the complex problems depends on its ability to develop an expertise among the population for attacking such problems.

Scientists and technologists, as well as political scientists, sociologists, policy-makers, citizens, people from all sectors of society, will be powerful forces in attacking these problems. Such a multidisciplinary group dictates that non-scientists as well as scientists must acquire knowledge and appreciation of science and technology and their potential for solving societal problems. Nonscientists, if they are to be effective policy-makers, members of a working, multidisciplinary team, or concerned citizens, must have some understanding of science and technology. Scientists must also obtain the skills necessary to work effectively with non-scientists.

This broadening of the skills required of scientists suggests an additional challenge: the separation of scientists and nonscientists in the classroom at the very least must be delayed until later in the educational process than the middle or secondary grades and at the very best must be based on different or additional criteria (or both) than used now (2).

Selecting the "future scientists" from the college-bound students with high IQ's, high standardized-test scores, and high grade-point averages has always

excluded some potential scientists. If continued, this approach promises to exclude even more given the changing qualities needed by the new "future scientists." Dede and Hardin (2) suggest that curriculum changes are not enough; the types of students exposed to scientific education must be broadened. They state, "These curriculum changes will make a difference, but they can only have a major impact when coupled with revised recruitment of students. Unless we begin to change both our recruitment practices and our curriculum, we are in danger of losing control of our pluralistic world because we attempt to orient technology around a monolithic elite." They go on to say that "encouraging early specialization at a time when development of multidisciplinary skills seems crucial [is] detrimental to science education."

The education symposia at the AAAS Annual Meeting in San Francisco, 24 February–1 March 1974, address many of the key issues concerning the developments in curriculum reform and the administration and evaluation of educational change.

Environmental Education

There is no better example of a complex societal problem than the deterioration of our environment. A solution will demand the awareness of all of society and the direct participation of people with diverse disciplinary backgrounds.

A symposium arranged by the AAAS Office of Science Education and the Consortium of Regional Environmental Education Councils (CREEC) explores the relationship of diverse disciplines—natural science, social science, and the humanities—to environmental education. J. Arthur Campbell, head, Department of Chemistry, Harvey Mudd College, will speak on the relationship of natural science to environmental education; Irving Morrisett, executive director, Social Science Education Consortium, Inc., will speak on the relationship of social science; and Carl P. Swanson, Institute for Man and His Environment, University of Massachusetts, will speak on the relationship of humanities. Members of CREEC will react to the comments of the three speakers.

Because scientific and technological advancements have a broad range of impact on the environment, changing public attitudes, manifested in new legislation, now make impact assessments necessary for any project or public policy change likely to produce significant change in the environment. Charles F. Cooper, director, Center for Regional Environmental Studies, San Diego State University, has arranged a symposium concerned with the role of science and technology in environmental impact assessment.

An opportunity to get out of the meeting room and into the environment of the Pacific coastline is provided by the American Nature Study Society in its symposium, "Involvement—The Key to Effective Environmental Education." The symposium will feature four speakers who are working directly with students, teachers, and administrators. The program is designed to provide basic information which sweeps from national and international programs to those of the Pacific area in preparation for the series of field experiences which will follow.

Broadening of Skills— Curriculum Reform

Two symposia, each taking a different perspective, are concerned with the educational changes necessary if our society is to effectively deal with its problems. "The Social Science of Science: A Strategy for Science Education in the 1970's" is arranged by Dorothy S. Zinberg, Harvard University, long an advocate of the need for a social science course for natural scientists. The symposium deals with the need to broaden university curricula to make natural science students more aware of the scientist's role in society, more responsive to society's needs, and more informed of the diverse options within a science career. The panel members will describe their experiences in teaching integrated science and social science courses as well as science courses for nonscientists and social science courses for scientists.

The other symposium, "Creative Responses to Contemporary Needs by Higher Education," arranged by the AAAS Office of Science Education and David G. Barry, professor of biology, Evergreen State College, considers curricular changes from the view of the college administrator.

"Modular Approaches in Undergraduate Education" and "The Technological-Humanist—A New Profes-

sional-Liberal Education" are examples of some of the new approaches to planning, implementation, and evaluation of new curricula to be discussed. "Response of College Administrators to Change" will illustrate the attitudes of college administrators to the new trends in higher education.

Broadening the Types of Science Students

Minorities and women are grossly underrepresented in the sciences as professionals in health sciences, research, and faculty in universities and colleges. The numerous reasons for their small numbers include lack of visibility of role models to encourage and motivate the potential scientist and conflict of culture and life-style that hampers motivation toward science careers. Minorities and women are needed in the sciences as professionals, however, if society is to solve its problems. Certainly no viable solution to the population problem can result without direct participation by minority group and women scientists in the development of new contraceptive methods and in other aspects of the problem.

Motivating and training minorities and women in science is the subject of a symposium arranged by Ciriaco Q. Gonzales, National Institutes of Health, on behalf of the Society for the Advancement of Chicanos and Native Americans in Science, and Vijaya Melnick, Department of Biology, Federal City College, Washington, D.C.

A second symposium, led by Leonard H. O. Spearman, director, Division of Student Assistance, U.S. Office of Education, will explore various graduate programs that focus on minority group

participation. The bulk of the discussion will focus on the effects of admissions policies, career orientation and placement possibilities, and the continuing development of strong graduate programs for minority graduate students on university life and on society as a whole. Of special interest will be the discussion of a federally supported program for minority graduate students in pupil personnel services work.

Policy Decisions

With the calls for changes in education, there is an increasing burden on the local, state, and national decision-makers and those allocating funds. Their role is indispensable in the process of educational innovation, therefore it is fitting to have some education symposia devoted to evaluation of educational innovations and educational decision-making.

The perspective at the governmental level is presented in a symposium arranged by J. Myron Atkin, dean, College of Education, University of Illinois. John Brademas, member of the House of Representatives and chairman of Select Subcommittee on Education; Thomas K. Glennan, Jr., director, National Institute of Education; and Michael J. Bakalis, State of Illinois Superintendent of Public Instruction, will discuss strategies for educational research and development initiated at the various governmental levels.

The science of decision-making is the topic of another symposium, and the evaluation of educational innovations, essential for the decision-makers, is the topic of a third.

These symposia concerned with the critical examination of new ideas and programs in education serve to put the suggestions for educational change in the proper perspective. Changes in the organization of educational institutions, in the curricula they offer, and in the criteria for academic success are all needed urgently if we are to meet the challenges of the future. Nonetheless, changes must be based on demonstrated need and likelihood for success. Thorough research and extensive evaluation are required to substantiate any proposed changes in the educational process.

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References

1. A. V. Baez, "Educational goals for the seventies," *Science Education News*, October 1973.
2. C. Dede and J. Hardin, *J. Chem. Ed.* 50, 583 (1973).