ED320758 1988-00-00 Recent Developments in College Science Programs and Courses. ERIC/SMEAC Science Education Digest No. 4.

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ERIC Identifier: ED320758
Publication Date: 1988-00-00
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Source: ERIC Clearinghouse for Science Mathematics and Environmental Education Columbus OH.

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WHY HAVE THERE BEEN CONCERNS REGARDING UNDERGRADUATE SCIENCE PROGRAMS AND COURSES?

Due to data released in several reports during the past three years concern has been growing regarding the status of undergraduate science in two-year colleges, four-year colleges, and universities.

Student interest in majoring in science and engineering has been declining. Freshman enrollments in engineering are down compared to 1982, computer science enrollments are down compared to 1983, physical science enrollments have never been high and have shown a decline, while biological science enrollments have been relatively flat. The percentages of minorities, women, and disabled students entering science and engineering programs continues to be low.

Student interest in majoring in science and engineering continues to decline while they are in higher education. Over 50 percent of the academically able students who enter college and pursue a science major decide to change to a non-science major. A high percentage of students who major in science and engineering end their studies at the undergraduate level.

At a time when a level of scientific literacy is important for all students, non-science majors frequently do not enroll in science courses unless enrollment is required by their program or the institution.

There have been several reports focusing on undergraduate science and engineering programs and courses during the past three years. Reports released have included those from (1) the National Science Board (1986), (2) a series of workshops sponsored by the National Science Foundation (1989) related to undergraduate physics, chemistry, biology, geoscience, computer science and engineering, and (3) reports published in conjunction with several professional associations including the American Chemical Society, the Society for College Science Teaching, the American Physics Teachers Association, and the American Society for Engineering Education.

These reports recommended that many program and course changes are needed.

Changes recommended include the following:

l) Programs and relationships with precollege schools and

students to increase the number and quality of entering

students;

2) courses, curricula, and quality of instruction;

3) laboratory facilities, and equipment;

4) use of technology;

5) programs to attract minorities and women to science; and

6) programs to retain students in science majors and to

attract others to science majors.

WHAT TYPES OF PROGRAMS AND ACTIVITIES HAVE BEEN DEVELOPED

WITH PRECOLLEGE SCHOOLS AND STUDENTS?Colleges and universities have established a variety of programs that involve precollege schools and students. While institutions have provided some of the financial support for these programs, the National Science Foundation and business and industry have also provided support. Among the current types of programs are the following:

l. Advanced Placement Courses

2. Summer programs for able students.

3. Summer programs for under represented groups.

4. Special courses during the academic year for able

students and under-represented groups.

These programs have been designed to increase the percentage and number of students entering science and engineering programs. National data indicate, however, that more programs are needed since these efforts have not reduced the overall decline in interest in science and engineering majors and the decline in women's interest in science and engineering. The number and percent of minorities majoring in science and engineering has increased.

WHAT ARE SOME CURRENT DEVELOPMENTS IN COLLEGE SCIENCE PROGRAMS,

COURSES, AND MATERIALS FOR SCIENCE AND ENGINEERING MAJORS?Recent program and course developments for science and engineering majors have included new developments and modifications of curriculum, technology and uses of technology, and instructional approaches used.

Curricula for science and engineering majors has been undergoing change and is continuing to be modified and changed. Modifications in curricula include (1) selection of new content and elimination of old, (2) reorganization of content, (3) increased emphasis on integration of content and interdisciplinary approaches, (4) increased emphasis on the liberal arts in programs for science majors, (5) increased emphasis on social aspects of science, (6) increased emphasis on communication skills, (7) inclusion of more research experiences, (8) inclusion of more content and experiences related to applications, and (9) attempts in some programs to reduce barriers that tend to cause students to drop out of science programs or not to enter science programs.

The use of technology has increased rapidly in science and engineering courses. The technology has been used to (1) expand and improve laboratories through the use of equipment for collecting and analyzing data and laboratory interfaces, (2) use technology for instructional purposes such as computer assisted and computer managed instruction, and (3) use technology as objects of study, particularly in engineering and physics.

Research on learning has also made an impact on the design of college courses, materials used, and instructional procedures for instruction at several institutions.

Some selected examples of programs that are being modified are described.

Drexel has been making a major modification of its undergraduate engineering program. The new program includes four integrated components. These are: (1) Mathematical and Science Foundations of Engineering; (2) Fundamentals of Engineering; (3) Engineering Laboratory; and (4) Professional and Personal Enrichment. The program stresses a body of knowledge, unifying and interdisciplinary aspects of engineering (rather than subject-discrete courses), use of experimental methods and the computer, communication, and social awareness and responsibility.

Institutions are making major modifications in their curricula based on the increased use of computers. Among the programs making major modifications are the physics programs at the University of Maryland, Dickinson College, University of California at Irvine, Cornell, M.I.T., North Carolina State University and West Point. Chemistry programs at Eastern Michigan University and Purdue University are among those

institutions making extensive use of computer technology. Biology curricula have been modified through extensive use of computer enhanced instruction at Colorado State University (Fort Collins), the University of Washington, and other sites.

Several institutions have developed courses based on the learning cycle format of Robert Karplus. This approach, based on the ideas of Jean Piaget, includes three different kinds of activities designed to help students learn and apply concepts and principles. The approach has been used in classes at several institutions including the University of Washington, Fairleigh Dickinson University, the University of Nebraska, and Kansas State University (Manhattan).

WHAT ARE SOME CURRENT DEVELOPMENTS IN COLLEGE SCIENCE

PROGRAMS, COURSES AND MATERIALS FOR NON SCIENCE MAJORS?Improving science education for all college level students has become a goal of many institutions.

A major effort to teach science to non-science majors involves over 30 colleges and universities. The New Liberal Arts Program of the Council of Independent Colleges has received support from the Albert Sloan Foundation to assist its work. Several topical units or modules have been developed and are being developed. Most emphasize (1) big ideas of science, (2) increasing student interest, (3) reducing unneeded mathematics and memorization of unneeded vocabulary, (4) use of modern technology for instruction, (5) demonstrations and laboratory activities, and (6) stressing interdisciplinary aspects of science and society.

Other institutions have also been developing courses to serve as part of the general education requirements. These courses include single courses or a sequence of courses that tend to focus on (a) basic concepts, methods, and connections in science, such as courses developed at Case Western University, Brooklyn College, and Lehman College and (b) courses stressing the interrelationships of science, technology, and society.

SELECTED SOURCES OF INFORMATION ON SCIENCE AND ENGINEERING

DEVELOPMENTS IN HIGHER EDUCATIONAmerican Association for the Advancement of Science

1333 H Street, NW

Washington, DC 20006

(202) 326-6400

American Chemical Society

1155 - 16th Street, NW

Washington, DC 20036

(202) 872-4388

American Geological Institute

National Center for Earth Science Education

4220 King St.

Alexandria, VA 22302

(703) 379-2480

American Institute of Physics

2000 Florida Ave., NW

Washington, DC 20009

(202) 232-6688

American Society for Engineering Education

11 Dupont Circle, #200

Washington, DC 20036

(202) 293-7080

National Science Foundation

Division of Undergraduate Science,

Engineering and Mathematics Education

1800 G Street, NW

Washington, DC 20550

(202) 357-9644

Society for College Teachers

National Science Teachers Association

1742 Connecticut Ave., NW

Washington, DC 20009

(202) 328-5800

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Staver, John R. Jr. and Others. A Summary of Research in Science Education - 1988. ERIC/SMEAC, Columbus, OH, 1989. SE 051 296. ----- Prepared by Robert W. Howe, Director and Charles R. Warren, Graduate Assistant ----- This digest was funded by the Office of Educational Research and Improvement, U.S. Department of Education under contract no. RI-88062006. Opinions expressed in this digest do not necessarily reflect the positions or policies of OERI or the Department of Education.

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Title: Recent Developments in College Science Programs and Courses. ERIC/SMEAC Science Education Digest No. 4.
Document Type: Information Analyses---ERIC Information Analysis Products (IAPs) (071); Information Analyses---ERIC Digests (Selected) in Full Text (073);
Target Audience: Practitioners
Available From: ERIC/SMEAC, The Ohio State University, 1200 Chambers Road, Room 310, Columbus, OH 43212 ($1.00 single copy; ordered in a set of four for the year and content area $3.00).
Descriptors: College Curriculum, College Science, Course Content, Educational Improvement, Educational Trends, Engineering Education, Higher Education, Program Descriptions, Science Curriculum, Science Education, Two Year Colleges, Universities
Identifiers: ERIC Digests
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