ON PHYSICS IN THE TWO-YEAR COLLEGE

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Historically, concern has been lavished on physics education at the level of the four-year college and university: Commissions have done hard work on the topic; authors have labored to produce "the ideal university physics text"; conferences have assembled fine minds to grapple with the problems. More recently, intense and widespread concern has been voiced in the United States with regard to education at the level of kindergarten through grade 12. (See, for example, Chiara Nappi's Opinion column in PHYSICS TODAY, May 1990, page 77.)

Yet it seems that the physics community has paid scant heed to a unique US institution of higher education: the two-year college.

In some geographic regions of the United States, two-year colleges have been a traditional part of the educational system for more than half a century. The California system is an example. Elsewhere, many institutions of this sort have emerged within the past 25 years. Over the 50-year period from 1934–35 to 1984–85, the number of two-year colleges jumped from 515 to 1221; enrollments went from 122 311 to 4 836 819. During the past 15 years, the number of associate degrees conferred by such colleges has nearly doubled. (Unless otherwise noted, statistical information in this column was supplied by the American Association of Community and Junior Colleges. The association, in turn, derives its data largely from the National Center for Education Statistics.)

Two-year institutions vary in type and emphasis, generally falling into three classes: comprehensive community colleges, junior colleges and technical colleges.

▷ In a comprehensive community college, students can fulfill general education requirements and take foundation courses recognized as the first two years of study in a major program. In many states, articulation agreements between comprehensive community colleges and four-year colleges and universities enable students who have spent their first two years in a two-year college to transfer without loss to a four-year institution.

▷ Junior colleges often have as their ultimate goal the granting of associate degrees, along with service to the local community.

▷ Technical colleges usually specialize in one-year programs leading to certificates in technical areas, such as allied health professions, or two-year programs leading to the associate degree in such fields as the engineering technologies.

Two-year colleges currently enroll 55% of the students who are in higher education for the first time, and one-third of the total students. Because of their lower tuition rates and favorable locations, two-year colleges have a higher percentage of economically disadvantaged students than four-year institutions. In these days of concern about changing demographics, it is important to note that of all black, non-Hispanic students in higher education, 42% are enrolled in two-year colleges. Fifty-four percent of the Hispanic students and 43% of Asian students are to be found in these institutions. Over 50% of all women college students are enrolled in two-year colleges. Today, a quarter of a million faculty teach in two-year colleges; of these, nearly 150 000 are part-time.

But how does this sector of the system of higher education impinge on the total physics community?

For one thing, every eighth graduate handed a baccalaureate diploma in physics (12%) has transferred from a two-year college.[1] This is a pattern of long standing—but we can increase this number.

Two-year colleges have the potential to bring more people into careers in science. Their large student pool has essentially been untapped. As can be said of all higher education, the percentage of students who elect science programs in these institutions is small. This is particularly true for those traditionally underrepresented in science careers, especially women and minorities.

But for the more than 4 million students enrolled in them, the two-year colleges represent the only realistic opportunity for pursuing an interest in science or improving scientific literacy through formal study. Because of the composition of their student bodies, they are uniquely positioned to increase science career interest among women and minorities. And these colleges deal with a large number of undeclared majors.

In the past, there has been little evidence beyond the anecdotal regarding physics in the two-year college. Certainly, the American Association of Physics Teachers has been concerned about physics education at this level. Two-year colleges have for many years had representation on the AAPT executive board. (It was when I served on the board as the representative of four-year colleges and universities that I became acutely aware of two-year-college issues.) There is a longstanding AAPT area committee on two-year colleges, with a newsletter. And good programmatic representation of two-year colleges is a regular feature of the AAPT national meetings. But AAPT has not had the resources to do systematic studies and recommend courses of action.

A 1989 National Science Foundation grant, together with support from The American Physical Society, has now made possible a modest beginning.

Joining these monies with its own resources, AAPT called together 120 key persons from representative geographic areas of the United States, Puerto Rico and Canada. The group met in Chevy Chase, Maryland, on 3–5 November 1989 for a conference entitled Critical Issues in Two-Year College Physics and Astronomy in 1990 and Beyond.

In preparation for the meeting, the conference steering committee (on

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which I served) developed a profile of the two-year college—its students, programs and faculty.

Poor student preparedness loomed large as a feature of the profile. Inadequate mathematics backgrounds, weak reading skills, inability to synthesize information—these problems of the two-year-college student are obvious stumbling blocks to success in physics. True, they are increasingly common in four-year institutions as well. But they are exacerbated by the open-door admissions policies common in two-year colleges.

The student body in two-year colleges also is uniquely heterogeneous. Nontraditional students such as displaced homemakers, persons changing careers and part-time students abound.

A diverse student body calls for a diverse curriculum. Many two-year colleges offer a standard general physics course—calculus based for science and engineering majors, algebra based for others. At some colleges a third course with minimal calculus is offered for premedical and other pre-health-profession students. Many two-year colleges also offer a technical physics course, with either of two intended audiences: engineering technology students or vocational technical students. Courses in physics for the nonscience student are frequently offered to satisfy general education requirements. Astronomy is a popular choice for this purpose; it may also meet a demand from the amateur astronomy community and the general public.

These varied offerings force two-year-college faculty members to do more class preparation on average than their four-year counterparts. Can the curriculum be streamlined? Not really. Curriculum design at an individual college is shaped by the needs of the geographic region in which the college is located, by accreditation requirements for specific career fields and by articulation agreements with programs at nearby four-year institutions. In addition, a typical two-year-college teaching load is 15 credit hours. What with advising, administrative and committee responsibilities, faculty members have little or no time for scholarly work. Further, money for professional-society memberships or travel to professional meetings is scarce.

These and numerous other issues were debated at the AAPT conference. Formal presentations by invited speakers set the stage for thoughtful discussion and action by small groups. Out of these groups emerged a set of recommendations directed to policymakers in physics and astronomy education as well as in the public sector.

The conference report, containing these recommendations, will be published by AAPT during the spring of 1991. It has the potential to effect real and substantial change in US physics. Meanwhile, there are specific and tangible courses of action open to concerned members of the physics and astronomy communities.

In the ideal state, partnerships would exist between physics and astronomy faculty at four-year colleges and universities and their counterparts at two-year colleges. Two-year-college faculty would play a part in research activities at the other institutions, enhancing their role as teacher–scholars. While this would be difficult to arrange during term times, summer and holiday schedules could be worked out. Four-year faculty would invite student groups from the two-year colleges to tour research laboratories, attend seminars and meet junior and senior physics and astronomy majors. A mentor system would be established within these groups of students. Two-year-college faculty would arrange for their four-year counterparts to speak to students on the two-year campus. Properly designed, these visits could serve as a recruiting mechanism for underrepresented students, letting them know that physics is not entirely a white male domain.

In the ideal state, professional organizations would have developed standards for physics and astronomy in the two-year college. These standards would speak to such issues as faculty teaching loads, laboratory equipment, library holdings and curriculum. Happily, AAPT has already developed such a set of guidelines for physics. The booklet is available from the association without charge.

Finally, in the ideal state, professional organizations would make yearly awards of a limited number of starter grants to physics and astronomy faculty from two-year colleges. These grants would support faculty attendance at a national meeting of the organization. Experience has shown that administrators at two-year colleges are more willing to provide travel funds for their faculty if an off-campus source has shown interest (in the form of dollars) in having them participate in meetings.

Reference

1. S. Ellis, P. Mulvey, "1988–89 Survey of Physics and Astronomy Bachelor's Degree Recipients," AIP, New York (April 1990). ■