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ABSTRACT

For millions of students, two-year college education represents the last real opportunity to develop an interest in science, mathematics, or engineering and to develop the prerequisite skills for a career in these fields. Yet, two-year college students represent a largely untapped pool of scientific personnel. Two-year college science and engineering programs share the same problems faced by four-year institutions. Retention is poor, with many students losing interest and switching majors and others being frustrated by the lack of preparation needed for success in science and mathematics courses. Only 20% of the community college students who enroll in a given science, mathematics, or engineering course plan to pursue a bachelor's degree in those areas. The reversal of this trend requires colleges to provide challenging, stimulating prerequisite or support courses, and the faculty to motivate students to continue their study. In addition, problems faced by faculty, including heavy teaching loads, isolation, the inability to keep current in their disciplines, and burnout, must be alleviated. Many of these problems have resulted from the abandonment of the classical notion of the scholar-professor and the resulting insulation of the craft of teaching from the scholarship that nourishes it. Faculty need this opportunity to be active and to explore current thinking in the disciplines they have chosen if their professional growth is to continue and they are to avoid burnout. At Montgomery College in Maryland, this challenge has been addressed through a scholarly activities program which allows faculty reassigned time to pursue such activities as writing a paper, participating in a performing arts activity, completing an artistic work, or creating a bibliography of current works in their field. The excellent community college should reward good teaching, and good teaching should show evidence of current and active scholarship. (JMC)

Critical Issues in Science Education in Two-Year Colleges: 1990 and Beyond

by Robert E. Parilla
President
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CRITICAL ISSUES IN SCIENCE EDUCATION IN TWO-YEAR COLLEGES: 1990 AND BEYOND

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Many of you are perhaps familiar with Eric Goldman's insightful, influential work, The Crucial Decade which examines the period immediately after World War II as a vital one for the United States in terms of political and economic change. I would like to suggest to you this evening that we are about to enter another crucial decade of change in which the United States will be enormously challenged to maintain a preeminent role in a world economy increasingly dependent on technological superiority. Certainly we are all aware of the growing economic power of countries such as Japan - we need only consult our newspapers to learn, for example, that Columbia Pictures or Bloomingdales or even such a symbol of American capitalism as Rockefeller Center, are being purchased by foreign interests.

How then are we to compete, and, we hope, to prevail in the upcoming years? America's strength and her greatest resource in the past, has always been a plentiful and educated workforce. The question is, can we count on that resource for the future? Statisticians tell us that by the turn of the century the workforce of the United States will be one-third minority. Estimates put illiteracy in our society as high as 20%. Where can an economy which requires a high level of skill and flexibility in its workforce expect to draw its strength?

I bring this to you as educators in two-year colleges because the most current information available suggests that it is at the community college level that a critical intervention can occur in the lives of students who might otherwise be lost, not only to the fields of science, engineering, mathematics and other sciences, but to education itself. Community colleges presently enroll 55% of first time college students, half of all the minorities in higher education, and over half of the women. Two-year colleges are producing more and more students who continue on to baccalaureate amd graduate degrees in science and engineering. The entire group of two-year college students is a largely untapped pool of scientific personnel for the country. For millions of students, the two-year colleges represent the last real opportunity to elicit an interest in science, mathematics or engineering and perhaps to obtain prerequisite skills. Two-year colleges, which provide access to higher education for those who might not otherwise have such opportunities, particularly minorities and low income groups, represent the last chance for many students to continue their formal education; further, they offer the first two years of college science, mathematics and engineering.

On the positive side, students enrolled in the science curricula are somewhat different from the general two-year student population. More of them are full-time, more state an intention to go on to four-year institutions, and they tend to have higher academic aspirations. Students majoring in the natural sciences are more likely to transfer to four year schools; those in science related fields such as the health occupations, computers and engineering tend to be preparing for the job market.

Unfortunately, two-year college science and engineering programs share the same problems faced by four-year institutions. Retention is poor; many students lose interest and switch majors. Only 20% of community college students who enroll in a given science, mathematics or engineering course plan to pursue a BA in those areas. Often students, similar to those in four-year institutions, lack preparation for science and mathematics courses, and they exhibit weak persistence when they are challenged. This is a particularly acute problem with minority students. Some fields are overwhelmingly male, and though minorities make up 25% of general science classes, they are underrepresented in computer science and engineering.

It would appear that as educators in the sciences, we need to become aware of loss of potential talent and energy in scientific fields when students are daunted by the nature of the classes, or discouraged because of lack of preparation. Let's examine some of the problems of such programs in the two-year setting, and explore some of the recommendations that have been made for energizing the science, mathematics and engineering programs. We have already discussed those problems which the students bring with them, such as lack of preparation, motivation, and lack of interest. There is evidence that as students progress in course work, a significant number become discouraged and do not retain interest. We will continue to lose these students until we can provide the challenging, stimulating prerequisite or support courses and motivate continued study. If we examine the science, mathematics and engineering faculty, however, we discover that often faculty members are not as professionally active as they should be to keep instruction timely and engaging.

There are limited professional development activities, heavy teaching loads, and a lack of interaction with colleagues to engender collegiality. In addition, there is a traditional lack of scholarly tradition in two-year colleges, and a perception that one cannot embrace both pedagogy and research.

In the fall of 1988, I had the opportunity to chair a National Science Foundation (NSF) workshop which looked at all these factors and came up with several recommendations which I would like to share with you.

There were five recommendations which addressed the needs of introductory science education in the program area and called for aggressive intervention in faculty development, student needs, and educational resources.

1. NSF should establish programs or an office for introductory science courses to enhance lower division education.

2. NSF should support faculty development opportunities to promote/enhance the scholar/teacher concept in two-year colleges.

3. NSF should support model programs and activities to attract and retain students, particularly from underrepresented groups.

4. NSF should establish programs that support curriculum revision, develop improved equipment and offer laboratory hands-on activities for introductory courses.

5. NSF should establish programs that enhance utilization of computers and other technological innovations for introductory science and engineering lab courses.

In addition, we proposed three <u>partnership</u> recommendations:

1. NSF and two-year colleges develop an ongoing partnership which enhances the participation of two-year college representatives in NSF activities.

2. NSF establish programs to encourage the formation of additional partnerships involving two-year colleges with business/industry, universities, public schools and others.

3. AACJC establish a task force for improvement of science, mathematics and engineering education in community, junior and technical colleges.

I believe that all of these recommendations are important ones, and if followed, can affect the state of science education for the future. However, my special interest in talking to you as educators, as science faculty, is to explore more fully the role of faculty development in providing the vigor and excitement necessary to entice our brightest students into the sciences and keep them there. As I mentioned, the NSF report of January 1989 points to heavy teaching loads, isolation and inability to keep current in disciplines as problems of science faculty in two-year institutions. In addition, many faculty feel burned out, perhaps bored, with repetitive introductory courses.

The faculty who are the crucial link to large groups of heterogeneous students in the introductory courses often do not project effectively to the unsure or wavering student. We are going through a period of transition that affects the community college at every level, but particularly at the level of faculty effectiveness, satisfaction and morale. Most of our current faculty were hired during the rapid expansion of the 1960's and early 70's and most are in their middle age. As such, they are beginning to come to grips with some of the life problems of their profession.

In the words of a higher education research report on faculty development:

> Faculty soon catch on to the fundamentally unchanging nature of their work. With the exception of special projects, what a faculty member does one year is pretty much what he or she will do the next year, and the year after, and the year after. This lack of variety tends to cause teaching to become more and more enervating. faculty members mature as the years go by; physically, psychologically, and in terms of their philosophy and technique. But the essential sameness of their lives remains (Brookes and German 1983, p.19).

The consequences of these conditions is the new academic disease - faculty burnout. Chief among the pressures cited by instructors was the lack of time to keep up with their discipline. Community college faculty generally enjoy fewer opportunities than do their four-year college and university counterparts to participate in professional activities that keep them informed in their fields. Fewer have sabbaticals, fewer travel to professional conferences or engage in professional activities beyond the campus (Killams 1974, p.12).

I believe that one of the serious problems within our community college system is the somewhat abandoned classical notion of the "scholar-professor." Basic research has been relegated to the university, and we have come close to insulating the craft of teaching from the scholarship that nourishes it. If we examine the concept of scholarship, however, it is apparent that, rightly understood, it is an indispensable adjunct to teaching.

I think it's appropriate to review some of the historical background which has led to this dichotomy concerning research and teaching. In 1895 University of Chicago President William Rainey Harper declared that "the crowning function of a university is original research. . . It is not enough that instructors should merely do the class and lecture work

assigned them." Heated debate concerning the relative role of teaching and research continued through the next several decades. The junior, or community college, as it has become known, began and grew partly in response to the growing preoccupation of the university with research. Harper and others conceived of the two-year college as an adjunct of secondary education which would shift the burden of undergraduate "preparatory" training away from the university and do a better job than the high schools (Blocker, Plumer and Richardson, 1965, p. 24).

It is time to redefine the concept of the "scholar-professor," and in so doing to energize and empower our two-year faculty. The relationship of teaching to scholarship is confused because we have not clearly defined and differentiated research and scholarship. Scholarship is not the same as basic research, and a distinction is necessary if community colleges are to encourage faculty to engage in such activity.

W. H. Cowley defines research as "The effort to discover new facts or to recover lost or forgotten facts. It is the empirical element in the quest for understanding the nature of the universe and man." Scholarship, on the other hand, Cowley says is "the organization, criticism and interpretation of facts, and thoughts of facts; it is the rationalistic element in the pursuit of understanding."

My belief is that community college faculty are not doing enough scholarly work. In order to sustain and nourish excellent teaching, faculty need the opportunity to be active in the disciplines they have chosen. The scholar-professor concept does not suggest that we abandon our commitment to teaching excellence, but rather that we allow faculty to inform that teaching with the love and knowledge that comes from opportunities to contemplate and explore current thinking in one's discipline.

I strongly believe we must reward those who wish to emulate this model, and to encourage continued professional growth among faculty. At Montgomery College, for example, we have developed a scholarly activities program which allows faculty reassigned time to pursue scholarly activity. Faculty are encouraged to engage in such activities as writing a paper, participating in a performing arts activity, completing an artistic work, performing non-paid consulting work in their discipline, creating a bibliography of current works on a discipline related topic, and many other projects. The program has been in operation for four years now, and has been well received by faculty. It is my hope that the program will continue to grow, and to provide new vitality to our instructional program as well as to act as an antidote to the spectre of "burnout" which can sap intellectual and professional vigor.

Certainly community colleges have made a major impact on higher education. They have motivated the previously unmotivated, helped the poorly prepared achieve, and have been at the forefront of making higher education universally available. However, with faculty members falling behind in the knowledge of their discipline and losing their interest and enthusiasm for teaching the same old thing, colleges must now define and encourage the development of the scholar-teacher. The scholar-teacher concept should be based on scholarship appropriate to the community college.

The excellent community college faculty member is a pedagogical expert, a scholar as defined here, and one who loves both teaching and the discipline. The excellent community college should reward good teaching, and good teaching should show evidence of current and active scholarship.

Let me return to my notion of the 1990's as a "crucial decade" for all of us. as educators, we recognize that science education provides the scientific resources which are critical for both our national welfare and for international competiveness. Our greatest resource is our people, and as I have told you, 50% of those individuals starting college begin with us, the community, junior or technical college. Just this week I received a copy of the report, "An Exploration of the Nature and Quality of Undergraduate Education in Science, Mathematics and Engineering," sponsored by the NSF and the Johnson Foundation. Many of the findings echo what I have been discussing with you tonight, particularly, the emphasis on quality teaching which the national advisory group lists as a first priority. Let me read two short quotes from the keynote address, A Profile of Undergraduates in the Sciences by Kenneth C. Green, of the Higher Education Research Institute at the University of California.

1) "Freshman interest in undergraduate science majors has dropped dramatically - by almost half - over the past 25 years."

and finally,

2) ". . .if undergraduate science departments were run like for profit business - that is, without substantial institutional subsidy - most programs might be bankrupt, largely because of their capacity, (some might say basic inclination) to 'alienate' potential clients."

I urge you to give your wholehearted support to Mr. Bassam Shakhashiri, Assistant Director, Science and Engineering Education, and Mr. Robert Watson, Director, Division of Undergraduate Science, Engineering and Mathematics Education, who have worked diligently to increase

participation by two-year faculty in National Science Foundations initiatives.

The challenge is ours for our own critical decade. I sincerely hope you leave here thinking of the potential that exists in each one of your classrooms, and asking yourself, "What can I do to seize this moment, and perhaps to capture a mind?"

Thank you.

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