HIGHER EDUCATION'S GREATEST CURRENT OPPORTUNITY AND RESPONSIBILITY

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Preparing the next generation of teachers at all levels from kindergarten through college is higher education's greatest current opportunity. Getting it right may be our greatest challenge. The face of science and technology is by definition changing constantly. Today, many feel that the most important work in science is going on increasingly at and across the interfaces of the traditional discipline. To serve our society well, education in the sciences, mathematics, engineering, and technology must change accordingly.

In my view, curricula at all levels (K-16) too often continue to reflect only the narrow traditional disciplinary approaches that science has taken in the past, in part due to the existing political structures within academe. Teachers should both appreciate and have understanding of the interdisciplinarity of scientific thought and technological application. I propose that the preparation of all future elementary school teachers contain an interdisciplinary emphasis encompassing all the sciences including mathematics; and that middle and high school science and mathematics teachers' training be largely interdisciplinary in nature as well.

The preparation of America's next generation of elementary, middle and high school teachers is higher education's greatest current challenge and responsibility. The data have convinced us that this is true for teachers of science and mathematics, and it appears to be so in other areas as well.

Within the last several months an array of national public figures and groups has called attention to this issue, and maybe, just maybe, higher education is beginning to respond; but it is not so clear that the seriousness of the response is commensurate with the seriousness of the situation.

President Clinton told the annual meeting of the NAACP in July 1998 of the need for more qualified college graduates to go into teaching, and in particular the need for minority teachers to serve as role models for inner city students. U. S. Department of Education Secretary Riley has said that "In the next ten years, we need to hire two million teachers to replace a generation of teachers who are about to retire, and to keep up with rising

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enrollments," and the National Commission on Teaching and America's Future has reported that more than half the teachers who will be teaching ten years from now will be hired during the next decade.

Our concerns extend to all of the areas of teaching, but the need for improved education of teachers in the scientific and mathematical disciplines is especially acute. Although there do exist many fine teachers who are well qualified in the sciences, their numbers are small within the total need, especially at the elementary school level. At the middle school level, the majority of these teaching science or mathematics did not complete majors or minors in the areas in which they are teaching. At the high school level, too often teachers whose training is largely in the life sciences are certified to teach physical sciences.

The opportunity that this serious deficiency presents higher education, and in particular the science and mathematics departments, is clear. College and university science departments, especially the physical sciences, are increasingly coming under attack by budget cutters as being too expensive, and having too few students to warrant majors programs. And it is all too true that Physics and Chemistry departments' undergraduate halls often echo with few footsteps after the students who are taking the lower division service courses, e.g. engineering students and pre-health careers students, leave the building.

But the budget cutters aren't the only ones complaining. Even the service courses need work according to Engineering and Life Sciences Departments, which increasingly are teaching mathematics and physical science to their own majors to assure they get the subject matter desired. For example, some engineering schools are now requiring only one quarter of chemistry from the chemistry departments.

Nor is the content of courses the only concern. In a recent study often cited, "Talking About Leaving", Seymour and Hewitt found that many science majors who drop out of science say it is because of poor teaching. But perhaps even more telling is the finding of the same study that students who stayed in and majored in science also complained about poor teaching.

Ironically, then, the societal need for future teachers with quality undergraduate science

and mathematics preparation comes at a good time in that it provides a great opportunity for these nearly empty science departments to fill up their upper division courses with a "new" major, those who will become teachers. This could rejuvenate many departments, perform a much needed national service, and as an added bonus probably end up being a recruiting device for traditional majors.

But this "solution" is far from simple. What is NOT needed are curricula designed for students expected to become scientists; such curricula have dominated science and mathematics undergraduate curriculum design for much of U.S. education history. What is NOT needed is for a department to assign one or a few individual faculty (who have fallen on hard times) who will reluctantly look after a less than favored set of students.

What is NOT needed are individual science departments approaching this issue totally independently from the other sciences and from the colleges of education. What is NOT needed are faculties who disparage careers in teaching, and who discourage their better students from moving in any direction other than toward the Ph.D.

What IS needed are curricula designed to provide future teachers with a reasonably quantitative as well as descriptive background in science and math, but that have a highly multi- and interdisciplinary character. Further, the fledgling teachers also must bring away from their education specific science materials and aids appropriate to the level they will teach to take directly into their future classrooms.

What IS needed are whole science and mathematics departments (not just an occasional interested person) willing and wanting to completely rethink their curricula aiming primarily at the needs of the majority of students who will not be moving toward Ph.D.s, or even other science majors, who will work together across the disciplines. What IS needed are faculty who are themselves teaching role models, who have learned to enrich their traditional roles as lecturers, e.g. using inquiry and group learning, especially at the lower division levels. What IS needed is a mobilization of the faculties of whole colleges of arts and sciences working collaboratively with each other and with their colleagues in colleges of education.

The complexity of the problem and its solution sometimes are daunting. Much of this is

vested in the territoriality that is so characteristic of much of academe. First, comes the need for faculty from the several sciences to collaborate. What many science faculty do not realize is that even secondary school teachers, let alone elementary teachers, rarely get to teach a single discipline in their careers. For just that reason (there are other, obvious, more substantive reasons) a multi-disciplinary teacher preparation curriculum is needed. Further, most of the undergraduate students who represent potential teachers will be found hanging out in the life sciences departments, whereas the greatest need is for the more quantitative preparation in chemistry, physics, mathematics, and engineering.

But the problem of communication among the scientific disciplines pales when compared to the communication problems that exist between the sciences and the colleges of education. In our view, it is essential that these entities work together if we are to achieve a truly good national system of teacher preparation. Yet, the norm even at traditional teacher training institutions is more nearly that of armed camps and fortress mentalities, than collaboration. At best, it seems a faculty member or two from each side will have good personal relations and contact with the other. But the needed systemic, institutional approach is indeed rare.

This conflict between colleges of education and colleges of arts and sciences was made almost laughingly clear at a meeting that the National Science Foundation and the American Association for the Advancement of Science collaborated on in 1995. We convened about 100 deans of both education and arts and sciences in Washington to provide an opportunity to seek ways for their collaboration. There we learned that some of these deans from the same campuses met each other for the first time at the meeting in Washington!

Fairly or not, in recent years higher education, especially the research universities, have come under increasing scrutiny and fire from the public and from state legislatures. It was reported in the Chronicle of Higher Education that many state legislators and policy makers believe that public colleges and universities care little about undergraduate education, especially education at the freshman and sophomore levels.

This unhappiness is not focused exclusively on the research universities. Recently, the school superintendent of a small city related that he had given up asking for help from his regional state university (formerly teachers college), where most of the teachers are prepared,

and found much better responsiveness from a nearby church related private college.

Rumblings in the U.S. Congress have already begun. Writing in the April 24, 1998 issue of the Chronicle of Higher Education, George Miller of California has accused university teacher training programs of perpetrating "fraud" both on the public and on the future teachers who think they are being properly trained. Even more recently in the May 15, 1998 issue of the Chronicle of Higher Education, Jeff Bingaman of New Mexico says he would deny Federal student-aid money to universities whose graduates can't pass state licensing exams. I believe that academe's serious attention to the problem of teacher education could be a major antidote to this growing disaffection with higher education on the part of public officials, which has not yet come to its fullness. Indeed, when state legislatures as well as the U.S. Congress come fully to comprehend that the key to success in improving teaching in the schools lies in the colleges, far harsher legislative mandates than yet seen are inevitable.

It would be incorrect to imply that no good models for change exist: there are; or that attention in the colleges isn't increasing: it is. I am very interested in learning about the models for change that are being developed in Virginia. For example, the bachelors degree in interdisciplinary science that is being developed at Virginia Commonwealth University includes many of the interdisciplinary components that I described earlier. With some modification, I think that the degree would provide excellent preparation for all high school science teachers. The add-on interdisciplinary science program that Longwood College is discussing would provide excellent preparation for prospective middle school teachers. The interdisciplinary course being developed and offered by Norfolk State University and the capstone interdisciplinary sequence that is proposed for future teachers by the University of Virginia are examples of the types of experiences that are crucial for all future teachers.

Much of the work taking place in Virginia and elsewhere is being supported by the NSF Collaboratives for Excellence in Teacher Preparation Program (URL:http//www.ehr.nsf.gov/EHR/DUE/start.htm or E-mail:undergraduate@nsf.gov). This program supports major reform projects that do involve collaboration among the scientific disciplines and with colleges of education, who do work together to produce multi-disciplinary curricula, new tools for fledgling teachers, and a rigorous but hospitable environment for the students. They also involve collaboration among the major teacher preparation institutions, including research

universities and community colleges, within an appropriate region. These projects are outstanding examples of solutions to the complex problem of teacher preparation. Nonetheless, they represent only a small piece of what needs to take place if higher education is to realize this opportunity.

If the opportunity that teacher preparation presents to higher education isn't sufficient, let's consider the responsibility side. No matter what higher education does -- whether the colleges and universities do everything they can and should do or whether they do nothing, one thing is certain: every classroom in America will have a teacher; no classroom will operate without a teacher; everyone of those millions of teacher positions that come open are going to be filled. They may be filled with bright people, well-prepared in their disciplines, and well-equipped with the best teaching and learning techniques. Or they may be filled with others; but they will be filled.

The quality of those millions of future teachers, as of the existing teacher corps, is the responsibility of higher education. It's also an opportunity. ■