Report on Academic Excellence

Reflections on Excellence in Science Education

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Mike Doyle asked me to use our experiences at Furman to illustrate some of the "best practices" in science education at private liberal arts colleges. I am happy to do so—even though I realize full well that I am preaching to the choir today. To one extent or another, all of our colleges are emphasizing what might be called engaged learning. That is, we promote a problem-solving, project-oriented, and research-based approach to learning that combines theory with practice, knowledge with action. Such an emphasis on engaged learning has helped liberal arts colleges bridge the gap between teaching and research and demonstrate that there is in fact a strong valence between the two enterprises. Liberal learning flourishes in an atmosphere of sustained inquiry. To learn deeply requires that we unleash our innate capacity for wonder—and then commit ourselves to the protocols and discipline of systematic investigation. A substantial research project heightens and hones all of the faculties through which we apprehend the world. The open-ended questing fostered by research addresses some of our deepest intellectual needs; our need to explore, assess, understand, and explain.

Of course, research involves hard work and disciplined concentration. Yet it provides some of our greatest pleasures and most enduring lessons. The regimen required of research forces us to pay attention to detail and to craft a mosaic of meaning from shards of evidence. There is an almost aesthetic delight in converting the chaos of facts into an explanatory pattern. Dorothy Wordsworth, the devoted sister of William, embodied such a tenacious spirit of inquiry. Once, during a walk in the woods, she crossed the brow of a ridge and came upon a stunning waterfall. She immediately began searching out its character, noting its resemblances, defining its differences, all with the passion of a discoverer, the exactness of a naturalist, and the rapture of a lover.

Such an impassioned yet analytical curiosity is as essential to effective learning as it is to effective teaching. We often learn best by doing and then by disseminating to others what we have learned. An ancient Chinese proverb expresses the benefits of such experiential learning. It says: Tell me and I will forget; Show me and I will remember; Involve me and I will understand. By involving a substantial number of students in research with faculty, liberal arts colleges are creating a culture of discovery that stimulates both intellectual curiosity and imaginative vision. Students engaged in serious research take greater responsibility for their own education—and assume greater risks. Their professors serve more as mentors and partners than as teachers, facilitating and guiding more than instructing. Such collaborative research usually strengthens the bonds between student and professor. It fosters an ongoing conversation about life and learning that speaks to the very essence of education. In this regard, our graduates often highlight their collaborative research projects as their most memorable learning experience.

At Furman, engaged learning is the animating theme of all that we do. It guides our approach to teaching and learning, shapes our budget priorities, and undergirds our extensive internship and research programs. Our undergraduate research program operates year-round but is anchored in the summer. As I speak, there are approximately 130 Furman students—mostly rising seniors—conducting on-campus research in every academic department. Each of them receives a stipend of $2600-$3000 for ten weeks of research. Some of them are funded through outside grants; most of them are supported by university and departmental funds. Whatever their academic discipline, these summer seekers forge a self-conscious community of learners. The student researchers and their professors converge for group picnics and banquets,

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participate in their own intramural sports program, and host corporate sponsors for lunch presentations. To reinforce their collective identity as a scholarly community, we provide all participants with T-shirts emblazoned with the FURP monogram.

Such a intentional community of scholars cuts across disciplines and departments and in the process helps address one of academe's greatest threats: atomization. Although humans are the most social of social animals, more interdependent, more attached to each other, more inseparable in our behavior than bees—we rarely nurture our conjoined intelligence. Jane Tompkins, until recently a distinguished English professor at Duke, has published a remarkably candid critique of the faculty culture she experienced in Durham. "For some time now," she notes, "I've been restless and dissatisfied with my life in the university, hungry for some emotional or spiritual fulfillment that it doesn't seem to afford. I crave a sense of belonging, the feeling that I'm part of an enterprise larger than myself or my department, part of a larger group that shares a common purpose." Tompkins goes on to describe the difficulty of establishing a sense of community within her own department of autonomous academics. Most professors, she observes, are on campus only long enough to teach their classes and host a minimum of office hours. Her colleagues at Duke, she declares, "are entrepreneurs whose aim is to enhance their reputation within a subfield, so that they can move up the ladder—receive more money, more recognition, a lighter teaching load and various other perks."

While important scholarship often results from such an outlook, it also means, according to Tompkins, that professorial loyalties and priorities are directed toward personal advancement rather than to colleagues or to undergraduates, and the result is the fragmentation of any sense of collective or shared purpose. Residential liberal arts colleges are in trouble to the extent that professors adopt such an autonomous and disengaged outlook. One of our shared challenges is to invigorate our sense of being learning communities, and at Furman we have found in collaborative student-faculty research one of the best ways of doing so.

Our comprehensive commitment to undergraduate research and a campus-wide spirit of inquiry did not happen by chance or occur overnight. It grew out of a model program created by our chemistry department 35 years ago. Today, the department's undergraduate research program is among the largest of its kind in the country. Each summer, about 50 chemistry majors participate in campus research projects directed by Furman faculty members. Another half dozen students travel to Los Alamos with Dr. Tony Arrington to spend their summer engaged in research there. Many of these students will co-author with their faculty mentor a peer-reviewed article resulting from these projects. Over the years, our chemistry department has demonstrated that an undergraduate research program depends fundamentally on developing a faculty dedicated to its success. The department includes diverse personalities but is bound together by a shared commitment to high quality student research. They aggressively work with the admissions staff in recruiting new students and awarding departmental scholarships. In the hiring and assessment of new faculty, the department and the Dean ensure that new colleagues are equally committed to such a research-centered teaching philosophy.

A related factor of great significance has been the 20-year leadership of Lon Knight, the department chair. I have never encountered a more dedicated or determined teacher and scholar. In describing his department, he recently wrote that "we are committed to overcoming every obstacle and taking advantage of every opportunity so that each faculty member can be recognized and respected as an accomplished scientist and as a researcher who works with students in a passionate and dedicated manner." Dr. Knight is not only a nationally prominent scientist but he is also an unstinting crusader for the undergraduate research program. He has had extraordinary success in cultivating alumni, corporate, governmental, and foundation support for his program. In the process, he and his colleagues have acquired an extraordinary array of sophisticated equipment as well as endowed scholarships and funds for student research stipends. The ten-member Chemistry Department has its own $2 million departmental equipment endowment and raises another $250,000 a year in corporate support and almost a million dollars annually in outside grants. They also have a full-time staff member who serves as a corporate liaison, providing equipment and services to area companies at no expense. The success of the chemistry research program has provided a kindling influence on the rest of our departments.

Today, every Furman department has its own student-faculty research program—all of which are subsumed within what we call the Furman Advantage Program. Since the program's first year, in 1984, there has been a dramatic increase in the number of students engaged in research, the number of outside grants garnered by faculty, the number of post-doc associates attached to our science departments, the number of books published, peer-reviewed articles produced, and papers presented, the amount of multi-disciplinary research, and the number of Goldwater scholarships awarded our students. As a case in point, during the past three years, the eight Goldwater scholarship winners at Furman had all participated

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in the summer research program. Furman science graduates are enrolled in doctoral programs at MIT, Cal Tech, Berkeley, Stanford, Yale, Harvard, Cornell, Chicago, Virginia, Duke, Emory, Chapel Hill, Purdue, Indiana, Illinois, Utah, Georgia Tech, Florida, and twelve other institutions.

Our undergraduate research program is not limited to the physical sciences. Its scope includes every department and every major. And all students – not just those with the highest grades—are encouraged to participate. An example of a recent multi-disciplinary research effort is Furman's River Basin Research Initiative. Launched in 1996, thanks to supporting grants from NSF, EPA, and the Rockefeller Brothers Fund, the project seeks to gauge the impact that urbanization is having on water chemistry and biodiversity. As the state of South Carolina wrestles with dramatic economic growth and urban sprawl, the research is very timely. Throughout the summer, chemistry, environmental science, and biology majors—as well as about a half dozen students from other liberal arts colleges—analyze hundreds of water samples, measuring nutrients, bacteria and other elements that impact stream chemistry and biodiversity. But field research represents just one component of this multi-faceted study. Political science majors assigned to the project work with governmental agencies that participate in writing legislation to improve water quality. Sociology majors, meanwhile, design and conduct nearly 1,000 telephone interviews of residents living in the area being studied, asking questions about their income, educational levels, recycling habits and perceptions of water quality. With more than 30 students, 13 faculty members and six academic departments participating in the project this summer, the River Basin Research Initiative is Furman's largest research endeavor. Next year, Furman professors and students will present a summary of their findings to the South Carolina Department of Health and Environmental Control. The results of three years of water testing, analyzing, polling and interviewing will directly affect regional economic development and land-use regulations.

For most Furman students, undergraduate research does not end with the arrival of fall term. Many present papers throughout the year at professional meetings and seminars. In fact, more than half the Furman students who participate in summer research projects make at least one off-campus presentation of their work at a professional conference or academic competition, and the university subsidizes their travel expenses. Furman has also been a perennial participant in the National Conference for Undergraduate Research. Each year we send 25-40 students to the conference, covering all of their expenses. These types of research-centered experiences do more than bolster a resume or graduate school application. They literally can be life-changing events. Research-based learning helps students clarify career goals while developing and applying skills that they have learned in the classroom. In our survey of graduating seniors, 92 percent of those who participated in undergraduate research found it "highly valuable."

Obviously, for a campus-wide research program to prosper, a college administration must support it. And this means financial as well as rhetorical support. In this regard, Furman spends about $200,000 on student research stipends each year—over and above the departmental budgets. In addition, in 1997 we established the Christian A. Johnson Center for Engaged Learning. The Center's director promotes and coordinates all engaged learning activities, on and off campus. Finally, we provide $5000 stipends to those faculty members who regularly sponsor undergraduate research projects.

Understood in this way, then, an undergraduate research program at liberal arts colleges bolsters our primary mission. Certainly we must guard against blindly mimicking research universities. Certainly we must avoid any mindless publish-or-perish mentality in faculty evaluation. And certainly we must value quality as much as quantity in scholarly activity. But such reservations aside, substantive research offers our students an instructive metaphor not simply for the scientific method but for life itself. Both research and life involve inward journeys that lead us through time—forward or back, seldom in a straight line, most often spiraling back and forth. Each of us is moving, changing. As we discover, we remember; through remembering, we discover. And we most intensely experience these sensations when our separate journeys converge.

As the Chinese proverb recognizes, "Involve me—and I will understand." Furman, like the other colleges represented here, has demonstrated that such engaged learning can be infused throughout the culture of a campus—with the right kind of leadership, commitment, and resources.

Dr. David E. Shi has been President of Furman University since 1994. He came to Furman from Davidson College, where he taught for 17 years and was the Frontis W. Johnston Professor of History. He is the author of several books, including The Simple Life: Plain Living and High Thinking in American Culture *(1985), which was a History Book Club selection. He is the co-author of the popular textbook* America: A Narrative History. *Most recently, he has written columns for* The Christian Science Monitor, The Greenville News, The Charlotte Observer, The Atlanta Journal-Constitution, and The Philadelphia Inquirer.