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CUR Focus

Perspective: Reasons Deans and Provosts (and Presidents) Should Value, Support, and Encourage Undergraduate Research

While some campuses, primarily liberal arts colleges, have long traditions of undergraduate research—some even requiring it of all students—more recently opportunities for undergraduate research have expanded to the full range of institutional types, including community colleges. It is useful to review the reasons this trend might be occurring and why academic administrators should find ways to value and support undergraduate research. It is also helpful to examine the benefits from research to students, faculty members, and campuses—benefits that are more apparent as a result of improved assessment.

As we begin, we wish to place undergraduate research in context. Occurring in institutions across the country and in many institutions internationally, it is one of several practices that have come to be referred to as "high impact" because of their demonstrable affect on student learning and student engagement (Kuh, 2008). The level and mix of the "high impact" practices varies considerably across campuses, with some concentrating on one or two practices and other campuses showing evidence of several forms at considerable intensity.

Undergraduate research is perhaps best seen as part of a continuum in an educational process that leads to higher-order thinking, application and integration. It can thus be viewed as the culmination of an educational experience that leads to original scholarly work. We see research as having several key components, including original work designed to make contributions to a field, as well as the necessary step of sharing the results with peers through presentation and publication. In its purest form, research by undergraduates is done by the same methods used by scientists or by the same methods of discovery used in non-scientific disciplines, and importantly the results are shared with colleagues consistent with the discipline (Malachowski, 2003). While we fully appreciate that undergraduate research is conducted in many fields, much of the following discussion stems from our own experiences working primarily in the sciences.

Preparing students for research should be part of curricular planning in a program or department and could be its ultimate goal, whether in an academic department or an honors program. Inquiry-based methods, open-ended laboratories, mini-research experiences using instrumentation and analysis can all be used as part of a process designed to prepare students to conduct research. We submit that, in current practice, the curriculum within STEM departments may not always be organized in a way that adequately prepares students to do science. All too often curricula are content-driven and overly descriptive, rather than focused on teaching students the process of science and preparing them to do science. Although we recognize that content knowledge is important, nothing can compare with the ability to pose a good question, make measurements, and generate and analyze data—these are skills that help students become life-long learners. Today's graduates need the skills to understand a process, evaluate quality, and synthesize information in a variety of situations, as well as the ability to think analytically. Although we are not expert in fields beyond our own, we have observed some of the same failings in programs in a wide range of fields, including the social sciences and the humanities. The ability to gather and analyze information is a critical skill regardless of the field, as is the ability to make a persuasive argument.

If we view undergraduate research as the pinnacle in a developmental process, we do not expect that every undergraduate at every college or university would be prepared to, or aspire to, conduct original research. Some colleges and universities might want to require research for all of their students, but in many cases this is not practical because not all students reach a developmental state that would allow them to be successful in conducting research. Expanding opportunities for students to do research is important, but making it a requirement may not be workable in all situations. In addition to the intellectual preparation of students, there are other limitations such as faculty time, space, and resources (Brakke, Nelson, 2003). We also caution against calling something "research" unless it contains all the attributes we expect in research—an original contribution to a field with public dissemination of results. Instead, we suggest that institutions consider requiring a capstone experience for students, with undergraduate research being one possibility. Other institutions may include service learning or an interdisciplinary capstone course.

We find many benefits deriving from undergraduate research, including contributions to a discipline. However, if seen solely in this light, by any measure undergraduate research would not

be an efficient process for advancing any field. Progress is often slow in working with undergraduates. Contributions to any discipline can be made much more easily in other ways and in different settings with graduate students, research technicians, and postdoctoral fellows. If the sole measure of the value of undergraduate research was research productivity, we would rarely do research with undergraduates. However, we find many benefits accruing from undergraduate research to the student. As a result, while contribution to a field is an admirable goal, it is not the primary reason for doing research with undergraduates.

The value of undergraduate research is a part of a educational process contributing to the learning and development of the student. This perspective is most natural and apparent at primarily undergraduate institutions, but it is by no means restricted to them. Maintaining an approach centered on student learning is perhaps less possible at a research university, where research productivity may be measured in numbers of publications or grant dollars received, rather than in educational outcomes for an individual student. Retaining a focus on student learning outcomes as opposed to research productivity can be a challenge without very intentional purpose and valuing of the experience for the student. We note that some progress has been made at research universities in response to the Boyer Commission report (1998), which examined undergraduate education and defined a blueprint for its improvement, and we note that undergraduate research has become one means of improving education at research universities (Katkin, 2003; Hu, Kuh, Gayles, 2007). Such improvements are noteworthy and in terms of the undergraduate experience can set one research university apart from another.

As we have noted, undergraduate research leads to the intellectual growth and cognitive development of the student. It can also produce changes in attitudes and improved confidence. All of the outcomes related to learning and attitudes can and should be assessed. Recent assessments of undergraduate research suggest that well-organized programs can produce many benefits to students that include but also go beyond cognitive development (see overview of such assessments in Crowe, Brakke, 2008). We know that students involved in undergraduate research gain self-confidence, are more likely to complete their undergraduate education, and are more likely to enter graduate school than are students who did not have a research experience (Lopatto, 2003; Crowe, Brakke, 2008). For example, a comprehensive study of NSF-funded research experiences showed that 29 percent of the students developed new expectations of obtaining a PhD (Russell, Hancock, McCullough, 2007). We also know that various intellectual gains result from undergraduate research. Based on our personal experiences and interviews with students, even if certain students decide research is not for them or they switch to another field, the intellectual benefit provided by the experience is enduring.

Additional benefits to students may not be so apparent, especially if undergraduate research is seen as an end to itself. While it may represent the culmination of an undergraduate experience, in many cases the experience is part of a process of preparation for graduate school, professional school, or the workforce in business and industry. In a recent survey of faculty members involved in biochemistry and molecular biology programs, all respondents said that "a strong undergraduate research program is the best preparation for graduate school" (American Society for Biochemistry and Molecular Biology, 2009). Medical schools, for example, are paying increasing attention to undergraduate research as they screen applicants. They see undergraduate research as evidence of initiative, creativity, and accomplishment. Many graduate programs view undergraduate research as an essential component of their students' preparation. Whereas undergraduate research was less common even a decade ago, it is effectively a requirement for entry into the best graduate programs today.

Perhaps even more recently, top companies hiring students for work in industry have also begun using undergraduate research as a screening tool for job applicants. Major companies such as DuPont and Pfizer may not interview applicants unless they have some research experience. Graduate or professional schools and industry have not published statements on behalf of research experiences; however they recognize that the experiences improve the communication, critical-thinking, and problem-solving skills of those engaged in the research process.

Thus, those who admit or hire our students have a powerful screening tool at hand. Given the way undergraduate research is being used in application processes, we must provide opportunities for students to be prepared for and to conduct research should they wish to do so. Fortunately, research opportunities for undergraduates have expanded as a result of direct institutional investment and through support from a number of programs, especially the Research Experiences for Undergraduates (REU) program funded by the National Science Foundation, the Ronald E. McNair Post-baccalaureate Program, programs at the

Howard Hughes Medical Institute, and grants from the Lancy Foundation. Nonetheless, the demand for quality experiences is continuing to expand.

Deans and provosts should be concerned about ensuring they can provide the appropriate number and quality of research opportunities their students need and that will be of benefit to them, including providing the necessary infrastructure of instrumentation or whatever tools are used in a discipline. A recent survey of faculty members from primarily undergraduate institutions suggests that teaching and committee loads are such that most faculty members do research during their academic breaks and that support for research by administrators tends to be verbal rather than financial (Sharobeam, Howard, 2004). Doyle (2002) suggests that hallmarks of excellence in a research program include: supportive start-up packages, matching grants for instruments, flexible departmental budgets, and a sabbatical leave program.

Lopatto (2003) summarized the essential elements in undergraduate research and the benefits faculty members view their students deriving from it. He also considered how students view their experience, concluding that the benefits of research for the student result from the interaction with and guidance from a mentor, learning how scientists think, finding how to overcome challenges and obstacles, and learning about a career in science. The benefits to students in enhancing their credentials, learning more about a field, and clarifying their career paths also are significant. Again, while contribution to a field is important, it is not viewed as the primary reason for undergraduates to engage in research.

We expect faculty members will do research with undergraduates at a wide range of institutions and across a variety of institutional types. At a primarily undergraduate campus, the research programs of faculty members may not move as fast as those of their counterparts at research universities, but they are active scholar-teachers who are current in their disciplines, and some of them display remarkable research productivity. Faculty members who are dedicated to undergraduate education and who conduct research with students derive great satisfaction in engaging in what is an ultimate form of teaching and of mentoring students. Opportunities for similar impact on students' development or preparation for their future are infrequent in large introductory courses or in other settings.

Even though there are some benefits to faculty members from involving undergraduates in their research, it is important to recognize their research may not always proceed as quickly but that the research with undergraduates has multiple benefits to students and faculty members. It is critical to find ways to value faculty involvement in enhancing student learning and development. Valuing undergraduate research requires consideration of faculty efforts in promotion, tenure, and merit decisions, and in setting faculty loads. Many colleges and universities speak of "teaching loads" as classroom or laboratory instruction quite separate from research. We would argue that undergraduate research is the highest form of teaching and should therefore be accurately reflected in the setting of teaching loads. We say this fully recognizing that it is much more efficient to teach a large class or even a smaller laboratory course, but we feel strongly that the value of undergraduate research in the education of the student is worth the expense (and effort).

Some argue that research informs teaching. While true to some extent, research topics can be far-removed from what might be covered in a typical undergraduate course. As scholar/teachers, we expect faculty members to be active in their fields and to teach in the classroom, laboratory, and in mentoring students in research. One of the benefits of undergraduate research to faculty members is the opportunity to take risks and conduct projects that may not result in publication but that will result in student learning. Such activities may include collaborative projects in interdisciplinary areas where the risk is high. The research should begin with a goal of publishable, original results. Experiments may not work and data may not stack up, but the efforts were original and exploratory. A failed experiment is nonetheless important and results can still be shared. If everything worked all of the time, our research would be easier regardless of the field.

The third benefit of undergraduate research is to the campuses on which we teach. There is little question that the best students seek opportunities to be involved in research and other activities in order to challenge themselves and to help develop themselves cognitively and in other dimensions. If they then have advantages in being admitted to the best graduate and professional schools as a result of their experience, it reflects directly and positively on the institution. Even though the benefits to a campus may be substantial, we note relatively little attention is paid to documenting the impact of undergraduate research on individual campuses. While the benefit to institu-

tions may not seem obvious if it is measured on the basis of students' future success, there are also immediate impacts from undergraduate research in terms of student engagement, which can translate into a long-term connection with a mentor and the campus.

Undergraduate research contributes to four of the five national benchmarks identified by the *National Survey of Student Engagement 2000 Report* by providing academic challenge, an enriching educational experience, active and collaborative learning, and student interactions with faculty mentors. By any measure, undergraduate research promotes active learning. It also results in greater connection and involvement of a student with the faculty and the institution. Providing a program of undergraduate research is intentional and designed to enhance educational development. What college or university's mission would not be enhanced or contributed to by an environment that provides opportunities for meaningful undergraduate research? And even though we have focused many of our comments on the sciences in this perspective, undergraduate research is expanding in a wide range of disciplines, including such fields as English and mathematics, in which scholarship has typically been done by individuals working in isolation. Collaborative research is possible in a wide range of fields.

A culture of undergraduate research that brings intellectual vibrancy to a campus and builds an engaged community of scholars also has rewards beyond the immediate group of faculty and student research participants. A collaborative research atmosphere attracts motivated students, talented and committed faculty and staff members, and engaged trustees, all of whose involvement further advances the overall academic program. Alumni with undergraduate research experience express significantly higher perceptions of personal and cognitive growth and greater satisfaction with their undergraduate experience (Bauer, Bennett, 2003). Such perceived added value from an undergraduate research experience can translate into more active involvement of alumni with their alma mater. This involvement can be manifested in many ways, including a greater presence on campus for alumni and college events; greater contributions of time in a variety of ways, including in admissions programs, professional and career development offerings for undergraduates, and departmental advisory committees; and more substantial monetary contributions to institutional programs and funding drives. All of these outcomes can be considered institutional benefits of undergraduate research.

A broad engagement in the pedagogy of collaborative undergraduate research will also provide an institution with a unifying educational objective and a common sense of direction. Such a cohesive purpose can create a strong network of support to sustain institutional progress. The importance and value of a particular pedagogical approach is amplified when it is applied in many different settings. Thus, a collective approach to student learning through undergraduate research is a powerful way to emphasize the importance of learning through discovery. Furthermore, the broad commitment to undergraduate research across an institution provides an opportunity to design a cohesive and consistent research program, rather than a collection of independent research initiatives. A successful and productive undergraduate research program can enhance the academic reputation of a campus, generate external recognition, and attract external funding for new equipment, facilities, and other purposes. An institutional commitment to undergraduate research further increases the opportunities for engagement of the campus in national discussions of trends in higher education and new research directions.

When viewed comprehensively, the multitude of successful outcomes of undergraduate research for our students, faculty members, and institutions have led to it becoming a valued part of an undergraduate curriculum and propelled undergraduate research to national prominence as an effective educational strategy. We call on deans and provosts to expand, support, and value undergraduate research. It combines the best in teaching and mentoring and has profound benefits to students and faculty members, and the work enhances the intellectual life of our campuses.

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