UNDERGRADUATE RESEARCH AND THE PROFESSIONAL SCHOOLS

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Undergraduate Research-What Prevents Business Faculty and Students from Participating?

Undergraduate Student Research in Humane Education: Benefits Gained in Action Research

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Cover Photo: Bentley business students engaged in service-learning research meet with Gina McCarthy (center), Environmental Protection Agency Administrator, during their study of the impact of energy literacy on U.S. workforce development and consumer spending. Students, L to R: Laura Yates ’13, Alyson Bisceglia ’13, Ryan Vermette ’13, Monica Tshanakas ’13, and Daniel Westervelt ’15

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In this issue of CURQ on the Web ............................................................................................................... Back Cover
We live in tumultuous and uncertain times. Issues facing us in the 21st century must be solved with a global perspective requiring evidence-based decision-making and well-considered policy design and implementation. We need a well-educated citizenry that is capable of problem solving, having been trained effectively to think critically, collaborate and communicate with others, and act in an ethical manner that is respectful of diversity and promotes inclusivity. Providing a college education to anyone who aspires to better himself or herself and contribute to society is not only a worthwhile goal, but a necessity to promote social equity and dignity for everyone. President Obama’s plan to provide free community college for all is a critical first step if we are to achieve a social structure that better balances wealth and power. Besides making higher education affordable to all, we must ensure that it is a quality education that truly provides the needed skills and knowledge that will help individuals realize their career goals and obtain employment and a good standard of living. Experiential learning that is problem- or project-based offers authentic, reality-driven opportunities for college students to gain discipline-specific knowledge that will better prepare them to enter our future workforce. Undergraduate research, scholarship, and creative activities (UR) can help us accomplish this goal.

We can no longer maintain the narrow focus that encourages undergraduate-research opportunities for only a chosen few who show an interest and aptitude for going on to graduate school. We must recognize that such learning needs to be offered to all students, including those who are enrolled in our institutions’ professional programs and who will immediately begin work as engineers, teachers, nurses, or business people once they graduate. This issue speaks, in part, to our failing to provide adequate models of UR that can be used by scholars and students in professional programs. The article by Shanahan and colleagues, in this edition of the CUR Quarterly highlights a few reasons why the professional disciplines are “underrepresented” in many UR programs. It suggests that there are “barriers to participation in UR,” including a lack of inclusive language about professional forms of scholarship and a dearth of varied formats for scholarly presentation. The authors also point out that faculty development for effective mentoring in the professions is either missing completely, is “overly general,” or is too science-focused.

CUR must help address these shortcomings and do a better job of promoting more inclusiveness. We must bring more faculty members engaged in the professional disciplines into the organization to provide networks for mentoring and collaborating that will help create more varied models of UR and develop common language about evidence-based practices. CUR’s two newest divisions, Health Science and Engineering, are trying to reach out to the faculties in more professional fields, but we need to do more to spread the word and bring a critical mass of like-minded individuals together to expand and create new divisions that can fill the professional void.

We also must do more to intentionally bring UR into the professional programs’ curricula and help design UR-based courses. The teaching-intensive demands at some institutions and the accreditation pressures on professional programs need to be addressed in new and creative ways. CUR is poised to offer assistance on this issue; one of our strategic pillars addresses the integration of UR into the curriculum, and we have a task force in place working toward innovation in this area. CUR also offers an institute that promulgates best practices for integrating UR into curricula, and we would like to encourage greater participation by faculty in the professional disciplines so that their ideas on experiential learning can be added to the discussion.

Bringing the benefits of UR to the students and faculty of the professional disciplines will move us much closer to achieving CUR’s and our nation’s goal of providing a quality education for all. Many students working toward a college degree are enrolled in professional programs. A large percentage of them are first-generation college attendees who do not have an experienced family or acquaintance network. My father was trained as a mechanical engineer as an undergraduate, the first in his family to attend college, in large part as a result of the GI bill after World War II. He supported five children throughout his 40-year career with the same employer. He, along with my mother, instilled in my siblings and me the desire for knowledge and the opportunity to explore our interests and ambitions. I am now the first individual in my family to obtain a PhD and use my education to help others become college graduates with employable skills and discipline-specific knowledge. By being a mentor to students engaged in undergraduate research, and being involved in advancing campus-wide UR opportunities at the University of Portland, I feel I am making opportunities available for students to achieve the “family firsts” that will bring them closer to realizing their career goals—and our nation closer to having a well-educated and productive populace.

Amelia J. Ahern-Rindell
CUR President
Associate Professor of Biology
University of Portland

From CUR’s President
I’m an admirer of many of the essays published in The Atlantic Monthly. A theme that runs through much of that periodical’s writing on higher education is the perceived tension between traditional liberal arts and career-oriented technical education. So when John Tierney wrote an article in late 2013 on the Maine Maritime Academy (MMA), one of six maritime training colleges in the United States—and one that boasts a post-graduation job-placement rate of more than 90 percent, with students finding good jobs, paying in the six figures to start—it was a paean to its lofty (literally, given the institution’s picturesque perch on the igneous rock coast of Maine), yet practicum- and career-focused academic culture.

Predictably, Tierney’s article could not pass without sparking a Twitter-fest. Tierney responded in subsequent posts that if the detailed commentary he received had any summative meaning, it was that institutions, whether “career technical” or “liberal arts” have pride in their cultures and accomplishments, and that institutional diversity is essential to meet diverse students’ needs.

This perceived tension between “career technical” and “liberal arts” education presents both a false dichotomy and a dangerous distraction from the work at hand, which is providing all students with excellent learning opportunities and preparation for myriad futures. Undergraduate research comes into its own as an important bridge between the “career technical” and “liberal arts” education emphases. Researchers including the University of Wisconsin-Eau Claire’s Heather Schmitz and Karen Havholm, who published their work in the spring 2015 CUR Quarterly, have clearly demonstrated the positive impact of undergraduate research for career preparedness in a variety of disciplines, including both liberal arts and professional schools.

The voices in this CUR Quarterly themed issue are also resonant and much needed. Several of the articles in this issue argue that the barriers to incorporating undergraduate research into professional schools’ curricula derive largely from misunderstandings of culture and vocabulary (see Jenny Olin Shanahan and others), and that benefits to students’ future career aspirations derive from provision of interdisciplinary, research-based curricula that target specific sectors of business and industry (see Ryan Bouldin and others).

Getting beyond the distractions of the discussion of “liberal arts” versus “career technical education” allows us to address a more urgent issue: how to provide larger numbers of students from less-advantaged pre-college environments with a quality undergraduate experience. Director Maggie Cahalan and her colleagues at the Pell Institute for the Study of Opportunity in Higher Education stressed at the February 2015 CUR Dialogues conference in Washington, D.C., (Cahalan, Franklin, and Yamashita 2015), the need for expansion of undergraduate-research experiences to low-income students, such as Pell grant recipients in the U.S. (analogous to recipients of Maintenance Grants in the United Kingdom, and Bourses sur Critères Sociaux in France). Such experiences are critical to increasing their college success rates.

This expansion can’t happen without wholesale engagement of career technical and professional schools, both in community-college settings, as CUR President Ami Ahern-Rindell urges, and at four-year institutions. A recent study by Sung-Woo Cho, James Jacobs and Christine Zhang at the Community College Research Center at Columbia University shows that Pell grant recipients enrolled at community colleges tend to cluster in “career technical” disciplines such as allied health, nursing, and business, or in general studies. So, if many low-income students are choosing professional schools/career technical training for their degree programs, we must have strong undergraduate research programs in place for them.

References


Elizabeth Ambos
Executive Officer
Research has increasingly become an integral part of the undergraduate experience in many fields of study in the liberal arts and sciences, taking an especially prominent role in students’ preparation for graduate study in most disciplines. This issue of the CUR Quarterly explores how the practice of undergraduate research has also become a critical component of the student experience in the professional disciplines, in some cases serving as a bridge for students to make connections between theory and practice and in other cases preparing undergraduates for lifelong careers that will require them to integrate research into their professional work. The articles presented in this issue describe some of the ways in which undergraduate research enhances students’ learning in professional majors and helps to prepare them for long-term success.

Jenny Olin Shanahan, Xiangrong Liu, Jennifer Manak, Suzanne M. Miller, Jing Tan, and Chien Wen Yu of Bridgewater State University provide an excellent introduction to the practice of undergraduate research in professional disciplines. They describe how participation in undergraduate research in Bridgewater’s School of Social Work and the Colleges of Education and Allied Studies and Business has grown at a much higher rate over the past few years than in the liberal arts disciplines, benefitting from a campus focus on making research more accessible to all Bridgewater students. Traditional undergraduate research opportunities at Bridgewater are increasingly looking at the language and models they use to promote undergraduate participation in research and scholarship to ensure that all disciplines are included in opportunities for funding and faculty and student development.

The CUR on the Web article from Jessica Lucero at Utah State University, “Engaging Undergraduate Social Work Students in Community-Based Research: Developing Research Skills through Hands-on Learning,” explores the connections between students’ classroom learning and the insights they gain from applying that learning to research in the communities they serve. Undergraduate research also prepares students for careers that demand continuous examination of practice in light of new findings, as described in the vignette “Integrating Evidence-Based Practice into Nursing Education: Partnering for Success,” by Joy Longo and Christine Moffa at Florida Atlantic University.

The introduction of undergraduate research in the professional curriculum may be a benefit to the program as well as the students it serves. David Schiraldi and Sheila Pedigo describe how the introduction of undergraduate research as a major component of an interdisciplinary engineering degree helped to revitalize and build enrollment in the major in macromolecular science and engineering at Case Western Reserve University. At Bentley University, business students...
may do research with an on-campus center promoting the development of science-based industry, helping students make useful professional connections through their research experience while meeting the goals of the university.

Professional students gain skills through undergraduate research experiences that position them well for future employment. Students of criminal justice and social work at Gannon University may participate in Christopher Magno’s class that leverages a community mapping project to teach students important concepts and skills in the context of community-based research. Magno’s paper (also offered in this issue of CUR Quarterly On the Web), describes how his course brings together community-based research, service learning, Geographic Information System mapping, and a close study of important urban issues and communities to provide students a way to build important job skills while applying classroom-based knowledge to address community needs. The importance of undergraduate research in preparing future teachers is discussed by Dennis Munk of Carthage College in another CUR Quarterly on the Web piece. The selected print and web vignettes extend the examples of undergraduate research in the professional schools, covering nursing, social work, speech-language-hearing, and kinesiology.

This issue provides perspectives on the value and practice of student research in pre-professional degree programs. We hope that it will inspire ways for campuses to expand undergraduate research into these areas of study, and stimulate new approaches that prepare students for careers in a dynamically changing world that requires a lifelong sense of curiosity, skilled teamwork, and analysis of evidence—skills that are gained through the pursuit of authentic research questions and applications.

Janice DeCosmo
University of Washington
CURQ Issue Editor
Bridgewater State University, the largest of nine state universities in Massachusetts with more than 12,000 students, was founded in 1840 by Horace Mann and is the nation’s oldest teacher-preparation institution (formerly a “normal school”). Thus excellence and innovation in education has been our heritage from the very beginning, which may help to explain why Bridgewater State’s teacher-preparation programs and other professional disciplines have embraced undergraduate research (UR) as an evidence-based practice. In the context of a tradition of advancing professional opportunities in the Commonwealth of Massachusetts, the UR program at Bridgewater State has successfully employed several strategies for including faculty mentors and students from professional disciplines in the university’s range of UR opportunities.

The most important context for our work in UR, and in all university initiatives, is our student body. Two-thirds of our 10,000 undergraduate students are the first in their families to attend college, are students of color, and/or are eligible for Pell grants. According to the Cooperative Institutional Research Program (CIRP) Freshman Survey, they work more hours per week than most American undergraduates, the majority working more than 11 hours per week during the academic year. Forty percent are transfer students, most from two-year colleges in the region. And 60 percent commute to Bridgewater’s 272-acre campus of traditional Georgian, red-brick buildings, 28 miles south of Boston. Despite their prevalent challenges, Bridgewater State’s students are competing in southeastern Massachusetts with students from some of the most renowned universities in the world for internships, practicum experiences, and, ultimately, graduate or professional school and career opportunities.

Our students’ need to distinguish themselves in an intensely competitive environment, coupled with their strong work ethic, have inspired campus-wide support—most notably by the current and former presidents and provosts—for undergraduate research opportunities and funding. Bridgewater State was recently recognized by the Council on Undergraduate Research as one of 57 colleges and universities “leading the way” in supporting student participation at the National Conference on Undergraduate Research (NCUR), to which we send about 50 students every year with full funding from the institution. We fund another 110 students’ travel to disciplinary conferences each year. We see the opportunity to present at conferences as key to students’ competitiveness; they build their resumes and gain valuable communication skills in presenting their scholarly work. They also network with people in their chosen fields, experience first-hand what others are researching and discussing, and develop confidence and a new concept of themselves as professionals.

Evidence abounds regarding the tremendous benefits to students of conducting faculty-mentored scholarly work (Astin 1997; Brownell and Swander 2010; Kuh 2008; Lopatto 2003)—benefits that have indeed transformed the future prospects for Bridgewater State students. Especially compelling is the literature showing that the benefits of participating in UR are most significant for students from traditionally underrepresented groups (Brownell and Swander 2010; Gregerman 1999; Locks and Gregerman 2008). First-generation and low-income students do not typically have the networking opportunities that some students with college-educated parents can utilize. Undergraduate research is a prime way for first-generation, low-income, and minority-group students across the country, including at Bridgewater State, to distinguish themselves academically and become sought-after candidates in a competitive environment.

For all of those reasons, UR is an essential part of our university’s commitment to social justice, particularly because faculty-mentored scholarly opportunities help “level the playing field” for first-generation, low-income, and minority-group students. UR is infused across the curriculum and throughout the culture of the campus. We contend that at any college or university, UR programs must be inclusive of all departments and schools, especially those with large numbers of majors, such as professional programs. And in light of employers’ needs for college graduates with the very skills that are developed through research, especially proficiency in oral and written communication and in solving complex problems (Fischer 2013; “Role of Higher Education” 2012), we see UR as an integral component of professional programs.

Because of the faculty workload required to mentor meaningful research experiences for students, it is important to note that Bridgewater State is a teaching-intensive, primarily undergraduate institution where full-time faculty typically teach four courses each semester. Therefore, while UR at Bridgewater State includes a vibrant, multidisciplinary sum-
mer program, grants for UR Abroad, and funded travel for all students presenting their research at national and regional conferences, much of our undergraduate research happens, by design, in the curriculum.

Research is infused in expected places in the curriculum such as honors theses, directed studies, and research-methods courses, but also in first- and second-year seminars, core and introductory courses, and in major/minor requirements for a broad range of programs. One of our annual campus UR events, the Mid-Year Symposium held each December, features more than 650 “beginning scholar” presentations on 100- and 200-level coursework. More than 600 upper-division students subsequently present higher-level research and creative scholarship every April in our Student Arts and Research Symposium (StARS).

Bridgewater State’s Bartlett College of Science and Mathematics and the College of Humanities and Social Sciences offer most of the UR opportunities and are responsible for the majority of the student presentations at the symposia on campus. However, students in the College of Education and Allied Studies, the Ricciardi College of Business, and the School of Social Work are participating in UR at rapidly increasing rates. In fact, the professional disciplines constitute much of the 64-percent growth in UR participation at the university in the past four years—from 1,056 students in 2009-2010 to 1,657 undergraduates in 2013-2014 receiving internal and external UR grants, attaining travel funding to present at national or regional conferences, and/or presenting scholarly work at a campus symposium (see Figure 1). Even these numbers do not account for all of the undergraduate research taking place in our curricula.

While the growth in the number of undergraduate researchers in professional fields is promising, their participation rates do not yet match those of students in the arts and sciences, as Figure 1 shows. For example, students in the Ricciardi College of Business make up 15 percent of the students enrolled at Bridgewater State, whereas they represent only 10 percent of the undergraduate researchers. Students in the Bartlett College of Science and Mathematics, meanwhile, are “overrepresented” in undergraduate research (see Figure 2).

The primary reasons that students majoring in business, education, and other professional disciplines are underrepresented in our own and many other UR programs are the lack of appropriate models of UR that fit those disciplines and lingering understandings about “research” that inadvertently leave out what scholars in professional programs do (Shanahan 2013). To overcome those barriers to participation in UR, we have employed the following strategies for building pre-professional research opportunities.

1. Inclusive Language about Scholarship. UR materials (e.g., grant applications and calls for abstracts) now include terminology that scholars in professional fields use. Asking management majors to articulate the “project goal” as an alternative to the “research question” makes sense when they are writing business case studies or developing supply-chain strategies. Likewise, in accord with scholarly expectations in education, student-teachers who are developing research-based lesson plans and reflecting on their implementation are invited to share curricular components and self-reflection in their UR grant reports.

2. Inclusive Modes of Presenting Scholarship. Campus symposium presenting student scholarship are now structured to include presentation formats used in professional schools. Symposium presenters and audiences alike ap-
preciate the inclusion of demonstrations of evidence-based (i.e., researched) practice, such as marketing-plan competitions, in which teams of students each have twelve minutes to put forth strategies for innovative marketing of a local business. Students in allied-health programs can present in an analogous way, with each member of a team playing a designated professional role and sharing the team’s therapeutic recommendations about a real or fictionalized case. Audience members often play the roles of clients or other stakeholders in the professional-style presentations, sometimes voting on or completing a brief evaluation of the students’ proposed interventions. Such interaction between student-practitioners and community members is a real-world model of how scholarship functions in professional disciplines.

3. Faculty Development Regarding Disciplinarily Appropriate UR Models. Strong UR programs rely first and foremost on effective mentoring. Yet professional development of faculty mentors is too often (a) based on practices that work in laboratory settings and follow scientific methods, (b) overly general or obvious (e.g., reminding mentors to be accessible to their research students), or (c) missing altogether. We have seen tremendous benefits, on the other hand, from tailoring development of mentors to particular programs. Colleagues within a program, school, or college share and receive meaningful, disciplinarily appropriate models of what student research looks like in their field, and they brainstorm new frontiers with those who know the discipline. For example, in October 2014, the Ricciardi College of Business hosted Gina Vega, author of The Case Writing Workbook (2013), for two days of faculty workshops on teaching research-based case-writing. Faculty members in the School of Social Work have built a scaffolded, research-rich curriculum by working together on research assignments that simultaneously meet disciplinary accreditation standards. They have developed common research goals for their foundational courses that are aimed at preparing students for advanced projects and evidence-based practice later in their undergraduate careers.

4. Professional Development for Students Concerning Research-Informed Practice. One of the crucial outcomes of disciplinary relevant faculty development in UR is a shared understanding of the place of student research in the field, which students then learn both explicitly and implicitly. For example, faculty in our College of Education and Allied Studies hear from colleagues at their annual development day about the research their students have conducted in the past year. Student poster presentations are even part of the schedule for campus visits of reviewers for the National Council for Accreditation of Teacher Education (NCATE), demonstrating to faculty and students alike the centrality of research to the profession of teaching. Education faculty and students at Bridgewater State have thereby developed common ways of talking about evidence-based practice. In myriad ways they embody the principle that research and practice must inform each other—in students’ internships, service learning, field work, and practicum experiences, as well as in faculty careers.

Undergraduate Research in Education

When pre-service teachers engage in undergraduate research, they refine their teaching skills, develop an appreciation for the role of research, broaden their knowledge of their discipline, and enhance their understanding of the connections between theory and practice (Lassonde 2008; Levy, Thomas, Drago, and Rex 2013; Manak and Young 2014; Slobodzian and Pancsofar 2014). Because UR provides pre-service teachers with the skills they need to become thoughtful, purposeful, professional educators, several faculty members in the Department of Elementary Education and Special Education at Bridgewater State have intentionally woven research assignments into 200-level introductory courses, as well as into upper-division methodology courses.

In introductory education courses, students are exposed to foundational research skills such as conducting a review of literature on a topic, engaging in participant observations, taking field notes, and presenting their research on campus and, in some cases, at the National Conference on Undergraduate Research (NCUR). In the introductory special-education course, students decide on an area of interest in the field, conduct research on the topic, and present their findings at a campus symposium. Students who are interested in exploring their topics further can arrange to conduct observation hours with a specific special-needs population or with an individual with a special need, often bringing together their research and community-service work.

A student in the 200-level Introduction to Special Education, for example, conducted research on a congenital disorder of glycosylation (CDG), a rare genetic disorder in which she first became interested because of her volunteer work with a seven-year-old child with the disorder. She acquired the necessary permissions and training to study the child’s communication skills over several months using an augmentative communication device, the Talkables IV. She was able to purchase the $200 device with a university UR semester grant. That student’s initial foray into research resulted in an NCUR presentation and an article published in the Proceedings of the National Conferences of Undergraduate Research. She went on to conduct research for an honors thesis and summer UR grant that ultimately landed her at CUR’s Posters on the Hill event in Washington, D.C.
In the Introduction to Elementary Education course, also at the 200-level, students engage in undergraduate research as they conduct their classroom observations. Students are required to observe three different grade levels at a public elementary school for a total of 40 hours over a semester. Some education faculty members at Bridgewater State have transformed that observational requirement into an engaging research assignment. Prior to beginning their classroom observations, students decide on focused topics they are interested in studying, such as the use of hand-held technological devices in elementary schools, differentiated and culturally responsive instruction, or middle-school classroom management. They conduct a review of recent research on their chosen topic and then develop research questions informed by the literature review. Their classroom observations are then framed by their research questions. In addition to conducting participant observations in the elementary schools, students interview teachers, parents, and administrators using questions that specifically address their research topics and which their professor has steered through Bridgewater’s institutional review board (IRB).

During the Introduction to Elementary Education course, students learn to write an abstract of their research; seek UR grant funding to support their travel to the schools and to provide small incentives for the research participants (such as a book for the classroom library); design a research poster; and present it at the campus symposium. Several apply to make presentations at NCUR. The topics of projects recently accepted for presentation at NCUR include language-immersion programs, gender equality in elementary classrooms, and interactive whiteboards (“SmartBoards”).

In many upper-division education courses at Bridgewater State, students engage in scholarly experiences such as conducting case studies on young readers, analyzing mathematics and science lessons conducted in elementary classrooms, and exploring various aspects of culturally inclusive instruction. Such research experiences are often not considered “undergraduate research,” mainly because the results are not disseminated. However, the assignments are often closely mentored by faculty, they engage students in original discovery, and they mirror the scholarly practices of the discipline—three of four essential characteristics of undergraduate research (Osborn and Karukstis 2009). But they are often seen as ordinary research assignments with a primary goal of assessing students’ knowledge, not as knowledge-discovery to be shared in the academic and professional community—the fourth characteristic of UR (Osborn and Karukstis 2009). Considering the transformative benefits of undergraduate research for pre-service teachers, department faculty are now discussing how students’ curricular research experiences, which are integral to nearly all upper-division education courses, can be revised and reconsidered as undergraduate research rather than as traditional course assignments that are rarely disseminated beyond the classroom.

In some of the upper-level education courses, faculty are now intentionally incorporating undergraduate-research experiences and have even secured grant funding for their students’ projects. For instance, students in the 300-level Science and Social Studies Inquiry for the Young Child course have developed a “STEM Family Night” for the community. They created “STEM stations” with experiments designed to introduce preschool children and their families to science and math activities. The students applied for a university UR grant to purchase supplies for the experiments, and they administered pre-event and post-event questionnaires to assess the families’ STEM knowledge and awareness and how they might incorporate STEM activities into their children’s lives.

Students majoring in elementary and special education at Bridgewater State frequently engage in independent, faculty-mentored research projects that are funded by summer UR grants and are the bases of honors theses. Such a project, “Exploring the American Revolution from Multiple Perspectives through Critical Literacy Discussions in a Fifth-Grade Classroom,” was presented at NCUR and Posters on the Hill in Washington, D.C., and was the first undergraduate-research project ever accepted for presentation at the conference of the Massachusetts Reading Association. It was a study of fifth-graders’ understanding of the diversity of people involved in the American Revolution after the students had read children’s literature written from various perspectives beyond those of British and American revolutionary men, including African Americans, Native Americans, and white women and children. Another student’s interdisciplinary honors thesis, “Literature of the First Encounters: Using Self-Immersion in the Scholarly Study of First Encounter Texts to Develop a Fifth-Grade Text Set,” similarly sought to broaden elementary-school students’ understanding of American history—in this case regarding the “first encounters” between Europeans and Native Americans.

Special-education majors have conducted summer research on young adults’ transitions from special-education support in high school to the less-supportive environments of jobs and other adult responsibilities. One such project, aptly titled “Falling off a Cliff,” was presented at an international conference on intellectual and developmental disabilities, as was another student’s study of community-based instruction for persons with severe disabilities. Other UR projects in special education have studied teachers’ roles in the self-confidence levels of students with dyslexia and the efficacy of “social stories” in easing transitions for young children with autism-spectrum disorders.
We know that framing teacher-preparation scholarly practices as “undergraduate research” is still rare in colleges and schools of education. One measure of UR in the discipline—NCUR presentations by pre-service teachers on K-12 education topics—shows a small rate of participation. Of approximately 4,000 presentations at NCUR 2014, only 50 were in the disciplines of elementary, secondary, or special education. Five of those, or 10 percent, were presented by Bridgewater State students. Only three articles on UR in teacher-education have been published by CUR Quarterly in nearly 20 years; one of them is based on the program at Bridgewater State (Manak and Young 2014). The other two are both by education faculty at The College of New Jersey. We hope that this article will inspire faculty and administrators in professional disciplines at other institutions to reframe as “undergraduate research” the scholarly work in which their students participate already, perhaps using one of the strategies outlined in the previous section.

UR in Communication Sciences and Disorders

A critical prerequisite for undergraduate researchers in the field of communication sciences and disorders (CSD) is an understanding of the scientific method as it is encapsulated in basic research design. At Bridgewater, faculty members in the program have embraced undergraduate research as a means of preparing CSD students for graduate study in speech-language pathology and audiology. By scaffolding research education throughout the undergraduate CSD curriculum (200-, 300-, and 400-level coursework), faculty have mentored students in acquiring basic knowledge of research design, which is essential for graduate study. For the past four years faculty have systematically introduced research education in the 200-, 300-, and 400-level courses to introduce students to the discipline’s scientific method over time. Students learn research-design principles, methodologies, and disciplinary research skills beginning in lower-division courses that help to demystify research, as well as through upper-level courses that require students to conduct empirical research studies.

In the 200-level Introduction to Communication Sciences and Disorders course, students learn that the information taught in CSD has been derived from anatomical and behavioral-research studies. They learn the differences among peer-reviewed publications, professional conference presentations, opinions of authorities, and web-based information. Concepts of evidence-based practices and various levels of evidence are briefly mentioned, although are not covered in depth.

Building on that foundation, in several 300-level courses CSD students learn the concept of evidence-based practice. Literature-review assignments focus on interventional studies in speech-language pathology; the students’ reviews must include assigning levels-of-evidence rankings to each study chosen. Writing assignments focus on interventional studies in speech-language pathology. In the 300-level Phonological and Articulatory Disorders in Children course, for example, students learn to conduct critical analyses and solve problems through the use of clinical cases. Students are assigned to intervention-planning groups, with each group responsible for creating an intervention plan for a simulated client that is developmentally appropriate, measurable, and containing achievable goals and objectives. The assignment requires students to provide a rationale from the research literature for their chosen interventions, thereby integrating theory, research, and clinical application within the area of speech sound disorders.

Likewise, in the 300-level Neurological Bases of Speech and Language course, students conduct research studies in small groups. Each group has weekly responsibilities based in problem-based learning, such as writing case studies in neuroscience; conducting mini literature reviews; developing original research questions related to course topics; designing methods and procedures for acquiring data for analysis (i.e., determining how they would set up a study of a topic of interest and then go about collecting data); writing project proposals; and obtaining and analyzing data. Examples of the groups’ questions include: “How do the speech, voice, language, and/or pragmatic characteristics of adults with early and later Parkinson’s disease differ during a narrative conversation?” “Is there a difference between word retrieval in spontaneous conversation and responsive naming in an individual with aphasia?” “What are the functional communication abilities post-stroke compared with pre-stroke communication abilities in an individual with aphasia?” (Miller and Ciocci 2014). These activities allow students to explore interdisciplinary connections among neuroscience, neuro-linguistics, communication disorders, and cognitive psychology, while also learning research design.

In other upper-division CSD courses, students conduct research studies as a whole class. Students in the Neurological Bases of Speech and Language course conduct a systematic review of the intervention literature on speech and language treatments following gunshot wounds to the brain, synthesize the data, and assign levels of evidence to each study. The topic took on added relevance in 2011 when Rep. Gabby Giffords (D-AZ) had sustained a head injury from a gunshot right before the semester began. Our class followed her progress closely, as her injuries involved a significant speech and language deficit. Students in another upper-division course, Voice Disorders in Children and Adults, planned a “Voice Screening Day” on campus. The students chose the topic and created the research questions, methods, and materials to carry out a campus-wide screening of student and faculty voices. Their findings ultimately were presented at the 2014
American Speech-Language Hearing Association (ASHA) annual convention—and they were the only undergraduates to give an oral presentation. Four students traveled to Florida to present the research on behalf of the class.

The next day when their faculty mentor made a presentation on undergraduate research in Bridgewater State’s CSD program, faculty from various universities directed their questions not only to the presenter but also to her students in the audience. Several attendees handed out business cards to the students, encouraging them to apply to graduate school at their institutions and remarking that they rarely encounter CSD graduate-school applicants who have conducted undergraduate research in the field.

Undergraduate research in CSD is not only valued by members of the professional organization (ASHA), but also by the students themselves, whose comments on teaching evaluations speak to the importance of conducting research in the discipline. Students in CSD attest to mastering the material in the courses in which they conduct research, as opposed to, as one student put it, “standard lecture and PowerPoint” courses. Student evaluations of courses since 2011, when the curriculum was revised to scaffold research assignments, convey higher levels of student engagement and excitement (Miller and Ciocci 2014). Representative comments from student evaluations of research-intensive CSD courses convey their enthusiasm for research:

“I found the research portion of the class extremely beneficial. First, I feel that I mastered the material much better than in other classes. I felt that because it was not your standard lecture and PowerPoint type of learning situation, that I was more engaged and excited to learn. I feel that [in] doing the research I not only mastered the information enough to understand, but I knew it well enough to educate others.”

“Overall, I thought that our research study was very successful. The fact that we were all assigned different tasks to do was great because we were able to come together as a team and put all our different creative ideas together. I learned a lot more about voice disorders than I would have if we were in a regular large class without the privilege of performing the study. The Symposium went wonderfully and I think we did a great job working together to present it.”

“I found the research project to be a great learning experience for several reasons. This was a fantastic opportunity. The knowledge foundation built from the text and in-class learning prepared us to explain our study confidently to participants during the Voice Screening Day. The reading of peer-reviewed scholarly journals in preparation to write the results, discussion, and conclusion sections of our project broadened my knowledge of current research, and we referenced these articles during our presentation. Presenting our research findings was a great experience: a first for me. I feel that the research and presentation approach to teaching this class ingrained the course information because I had to explain it to the many people who asked questions during the Research Symposium. There’s something to be said about being held accountable for what you say and claim to know to be true. I, like my classmates, am quite proud of our project.” [emphasis added] (Miller and Ciocci 2014)

In addition to course-embedded research, majors in communication sciences and disorders at Bridgewater are afforded opportunities for independent, faculty-mentored, grant-funded research during the university’s summer UR program. Recent summer-grant recipients have conducted a diverse range of research studies in CSD, including an empirical study of voice disorders in theater-arts students; a systematic review of intervention studies in childhood apraxia of speech; an intervention study examining working memory in early-elementary school children; an investigation of the speech-fluency development of preschool children who are English-language learners; and a case-study analysis of cognitive and linguistic functioning in an individual with a rare occurrence of atypical language dominance and aphasia. Students have presented their research at NCUR, as well as at campus symposia.

**UR in Business Management**

Because of the visibility of undergraduate research at Bridgewater State, faculty in the Ricciardi College of Business receive multiple inquiries every semester from business majors interested in pursuing research opportunities. That visibility and the “campus culture” of undergraduate research are undoubtedly key to the growth in UR participation by students in management and marketing at Bridgewater in the past five years. A recent study conducted at Texas A&M University on low rates of participation in UR by business faculty and students concluded that business students held misconceptions about what constitutes “research” and had “difficulty figuring out the benefits they would have received from a UR experience,” opting instead for internships and other “more obviously beneficial activities” (Mathis, Ramos, Gonzalez y Gonzalez, and Datta 2014). Meanwhile, if business faculty perceive that their students are not interested in undergraduate research, they may conclude that it is “not worth their time” to recruit student-researchers. As the authors of the study point out, “these two misunderstandings reinforce each other to create a climate in which students do not seek UR experiences outside the classroom and faculty...
see no reason to offer them” (Mathis et al. 2014). Business
students at Bridgewater State, a smaller institution, may have
more occasions to see UR in action and learn about its ben-
efits from peers in other programs. Their pursuit of UR op-
portunities has inspired faculty in the college to translate
student interest into meaningful research projects in busi-
ness. Management faculty at Bridgewater have done strategic
planning to create a research-rich curriculum and are utilizing
university resources for mentoring independent student proj-
ects through directed studies, the summer UR program, and
grant-funded UR opportunities abroad.

Myriad reports in recent years indicate that the most im-
portant skills employers are looking for in recent college
graduates are problem solving and critical thinking (Fischer
2013; “Problem Solving” 2011; “Role of Higher Education”
2012; Scott 2013; Taylor 2010). Employers want to hire col-
lege students and recent graduates who can accurately iden-
tify problems, seek alternative approaches, think critically,
derive solutions, interpret data to make informed decisions,
and communicate their insights to stakeholders. Faculty who
are interested in improving students’ critical-thinking and
problem-solving skills cannot simply rely on assigning the
standard cases described in textbooks. Through UR they can
provide much more valuable opportunities for students to im-
prove their skills, and therefore their marketability, through
hands-on experiences. UR in business emphasizes the appli-
cation of theory to the practice of management, bridging the
gap between the concepts taught in business school and real-
world situations (Liu 2014).

UR has become, therefore, an important part of our pedagogy
in the business curriculum at Bridgewater State. An upper-
division Production Operations Management course, which
covers mathematical methods such as linear programming
and data envelopment analysis (DEA), can be too abstract
for students without the opportunity for real-world applica-
tions (Liu 2014). In Spring 2014, students worked in small
groups to conduct research on the efficiency of coal-fired
power plants in the United States. Each group was responsible
for one U.S. state; they learned about the state’s regulations
and the industry’s background there, and they modeled the
power plants’ efficiency using data from the Environmental
Protection Agency (EPA).

Students came to understand the complexity of the problem,
the messiness of the available data, and some important uses
of mathematical modeling. They also observed the impact
of pollution-emissions issues on the production decision-
making process. The professor who taught the course has
conducted extensive research on coal-fired power-plant effi-
ciency, so she became an expert “consultant” for her students,
who in turn helped to inform her ongoing research. In a sur-
vey conducted at the end of the semester, students rated the
development of their research skills on a Likert-scale from 1
(strongly disagree) to 5 (strongly agree). Their weighted aver-
age on two key statements—“I am better prepared to conduct
Operations Management research” and “I have a better ap-
preciation of the challenges of modeling real-world decision
problems”—were 3.92/5.00 and 4.15/5.00, respectively, indi-
cating solid agreement (Liu 2014).

In another upper-division course, Supply Chain Management,
students not only read business cases published in the text-
book, but also write cases based on their own research. They
investigate the major issues in the business operations of a
particular organization and examine potential applications
of supply-chain models. In this course, the research design
and content are driven by the students’ interests and enthu-
siasm. Students from these and other management courses
share their business cases and insights with diverse audiences
through high-profile public presentations at the university’s
undergraduate research symposium.

In addition to participating in whole-class research projects,
some Bridgewater State business students also seek out in-
dependent research opportunities. Their projects are actual
business activities that include community outreach and
produce tangible outcomes. In 2013-2014, for example,
three students participated in a directed study that examined
how Chinese languages and culture are taught in the United
States. They conducted a program review of a Chinese-
language school, conducted a strengths-weaknesses-opportu-
nities-threats (SWOT) analysis of the business strategy of the
Confucius Institutes of New England, and carried out a feas-
bility study regarding the establishment of a Chinese school
in Boston, Massachusetts. The students made multiple site
visits to Chinese-language schools in New England, distrib-
uted more than 400 questionnaires, conducted numerous
in-depth interviews, and reported on their findings at seven
different conferences and meetings. One of the students is
currently co-authoring a paper with her faculty mentor for
an international conference in Shanghai.

Another team of five business students conducted a mar-
ket analysis for the regional airport in New Bedford,
Massachusetts, resulting in a report for airport managers
and a co-authored presentation at a transportation-research con-
ference. Another directed-study team project conducted by
three business students resulted in a community-development
study of the economic impacts of the Panama Canal
expansion on U.S. ports in the Northeast, especially the Port
of Boston, as well as on the development of a new cruise line
from Boston to the Caribbean.

Business students in the honors program at Bridgewater
State, who are required to complete a two-semester thesis for
departmental honors in management, have developed proj-
UR in Social Work

Educating competent professionals who promote the well-being of individuals and communities is the ultimate goal of education in social work. The Council on Social Work Education (CSWE) uses Educational Policy and Accreditation Standards (EPAS) to accredit baccalaureate- and master’s-level social work programs. The most recent EPAS (2008) are based on competency; they adopt outcome-performance approaches to curriculum design. In other words, social work curricula are no longer based on content sequences (such as diversity, human behavior, policy, research, practice); students are now expected to achieve “professional competence” by graduation.

Engaging social work students in research is critical to the development of the core competencies, as well as for preparing students to engage in active knowledge-seeking, lifelong learning, and the assessment of changing political climates. Yet student attitudes about engaging in social work research have been shown to be complex; faculty need to assess students’ readiness for research at the outset (Secret, Ford, and Rompf 2003). Social work students generally have high anxiety and low confidence about statistics and research, and many struggle with research courses. Some students are interested in social work as a helping profession, often without realizing initially that the discipline employs scientific methods and statistical analyses. According to Moore and Avant (2008, 232), “research courses appear to be the most negatively viewed by, most feared by, and least helpful to social work students.” Some of our students try to put off statistics and research-methods courses until later semesters, which can extend their time to graduation. Many express to their academic advisors their negative attitudes about research, either showing disinterest or not believing they can do it. The faculty member who primarily teaches statistics for social work students. “Some of our students try to put off statistics,” Moore and Avant note. “Many struggle with research courses. Some students are interested in social work as a helping profession, often without realizing initially that the discipline employs scientific methods and statistical analyses. According to Moore and Avant (2008, 232), “research courses appear to be the most negatively viewed by, most feared by, and least helpful to social work students.” Some of our students try to put off statistics and research-methods courses until later semesters, which can extend their time to graduation. Many express to their academic advisors their negative attitudes about research, whether showing disinterest or not believing they can do it. The faculty member who primarily teaches statistics for social work students begins the semester by asking students to assess their degree of confidence about succeeding in the course, on a scale of 1 (“cool as a cucumber”) to 10 (“panic attack”); she reports that the average score is always around 7.

Moore and Avant (2008) recommend that social work students’ experiences in research begin early in their undergraduate careers, with an infusion of research in many of their courses, so that their skills in and knowledge of research can develop throughout the curriculum and prepare them for advanced projects in later courses. Traditionally at Bridgewater State, important research concepts and skills had not been introduced or emphasized in social work curricula until students reached upper-division courses such as Data Analysis/Statistics and Research Methods. More recently, in an attempt to demystify and reduce student fear about social work research, we have developed various UR opportunities in early courses. Utilizing syllabus-development strategies, our social
work curriculum is now infused with research projects utilizing multiple university opportunities available to undergraduate students. We believe that these curricular revisions promote the development of the core competencies, such as “apply critical thinking to inform and communicate professional judgments” (Council on Social Work Education 2010, 4) and “engage in research-informed practice and practice-informed research” (Council on Social Work Education 2010, 5).

In Bridgewater’s Introduction to Social Welfare course, students are now required to create and present a research poster at the university’s UR symposium on their community-based research experience. For this beginning research presentation, their posters must include specific information regarding the history and mission of the organization in which they conducted their service-learning and research; its financial, political, and community support; its human diversity; and its social location. Students are also coached on conference-presentation etiquette from the very beginning of their social work education.

In the 300-level Social Welfare Policy course, the major assignment has been converted to a policy-analysis paper. Throughout the semester students submit scaffolded sections of a comprehensive policy analysis; by the end of the course, they write the policy-analysis research paper following APA guidelines. In addition to learning how to conduct policy research, students learn the requirements of rigorous academic writing. Instead of taking a quiz asking students to analyze a dataset provided by the instructor, students in the 300-level Data Analysis course are now required to develop a research question of their area of interest, create a survey with three or four variables, collect data, analyze the data, and write a data-analysis report—in other words, to carry out a trial research project in a manageable way.

The major assignment of the 300-level Research Methods course has also been overhauled, shifting from a research proposal to a paper on evidence-based practice. The assigned paper is designed to help students practice a part of the evidence-based practice (EBP) process, which provides a framework for accessing and critiquing research evidence to assist in making informed practice decisions. Students are asked to follow EBP steps for a real-life, social work issue affecting a specific, defined population (e.g., depression in older adults, post-traumatic stress disorder in returning veterans, substance abuse in teenagers).

At the 400-level, students in Macro Social Work write a comprehensive paper on a community intervention that includes an explanation of the magnitude of the social issue, a literature review, theories and interventions, and a community-intervention evaluation. During the semester, students also complete a grant application to support their activities.

Besides engaging students in UR in the curriculum, our faculty members in social work have mentored student researchers in a variety of independent projects and in collaborative research abroad. Students who joined the bachelor’s program after the curriculum revision began in 2010, and therefore have engaged in primary research activities at the introductory level, are much more active than the students before them in pursuing co-curricular UR opportunities, such as honors theses and independent research projects in the summer. Before the curriculum revision, only one social work major had applied for an undergraduate-research summer grant in 10 years (between 1999, when the grants were first offered, and 2009). In the four years since the curriculum revisions began in 2010, five majors have been awarded summer research grants. Recent grant-funded UR projects have studied available resources and potential barriers for LGBT (lesbian, gay, bisexual, transgender) homeless youth in Boston; treatment methods for women military veterans with post-traumatic stress disorder; and the experiences of transgender students in Massachusetts’ colleges and universities.

Before 2010, students in social work did not present at campus research symposia; at our 2014 Mid-Year Symposium of Undergraduate Research, more than 100 majors presented posters or talks, mostly on their community-based research and practicum experiences. Two years ago, one major’s practicum-based research study, on shelter educational initiatives for school-age children experiencing homelessness, was presented at CUR’s Posters on the Hill event in Washington, D.C. The student was invited to meet with then-Senator Scott Brown (R-MA) about the student’s findings. Research based on students’ practicum experiences can also provide valuable information for the agencies and for the clients they serve. The results of another student’s study, titled “Geriatric Competency, Training, and Services: Surveying a Local Aging Access Point,” helped the agency to better understand its staff and services, according to the student’s practicum supervisor.

Teams of social work majors and their faculty mentors have been awarded university UR Abroad grants to study social-support systems for the elderly and the role of social workers in elder care in China and Belize. Their work highlighted the tremendous need for social supports in a diversity of cultures in which elders have been traditionally cared for by family members. They found that demographic and economic changes are shifting responsibilities for care of parents and grandparents to community members and social-service agencies.

Conclusion
The UR program at Bridgewater State has successfully employed several strategies for including faculty mentors and students from professional disciplines in the university’s range of UR opportunities—from summer and semester grant-funded projects, to honors theses, community-based research, UR abroad, and research presentations at national
conferences and campus symposia. The key tactic has been to infuse research into the curriculum, beginning in introductory courses, to build students’ familiarity with and skills in research. Their initial forays into research in the discipline are then intentionally advanced in upper-division courses and practicum experiences. With that strong foundation of research in the curriculum, students in professional majors at Bridgewater State are well prepared for more independent research in the summer UR program, honors-thesis work, and UR abroad. They also present in significant numbers at campus UR symposia, NCUR, and professional meetings.

References


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Jenny Olin Shanahan is director of undergraduate research at Bridgewater State University, where she oversees student research and creative scholarship across the disciplines, two annual campus symposia of several hundred students’ scholarly work, and publication of *The Undergraduate Review: A Journal of Undergraduate Research and Creative Work*. She previously was associate professor of English and director of the honors program at St. Mary’s University of Minnesota. Shanahan has presented more than 30 faculty workshops on the mentoring of student researchers and writing across the disciplines. She has published articles on integrating undergraduate research in the curriculum, scaffolding scholarly skills from lower- to upper-division courses, and managing an undergraduate research program. She is a member of the Executive Board of the Council on Undergraduate Research (CUR) and a CUR Councillor in the
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Xiangrong Liu is an assistant professor of management at Bridgewater State University. Her research focus is mathematical modeling with applications in supply-chain management, with her research topics including sustainability issues such as remanufacturing, pollution-emission controls, and renewable energy. She has published two research papers as book chapters and one teaching case in a peer-reviewed journal. Liu actively promotes undergraduate research in the College of Business and implements undergraduate-research pedagogy in the courses she teaches. In 2014 she mentored a grant-funded UR Abroad team of students conducting research on the solar-power industry in China. She has a PhD in business administration from Drexel University, with a concentration in operations management.

Jennifer Manak is an assistant professor in the Department of Elementary and Early Childhood Education at Bridgewater State University. She teaches undergraduate and graduate literacy courses, co-coordinates the university’s undergraduate research program, and is a faculty associate in the Office of Institutional Diversity. Manak facilitates CUR workshops on integrating undergraduate research into the curriculum and has presented on undergraduate research in the field of education at two CUR conferences.

Suzanne M. Miller is associate professor of special education research in the field of education at two CUR conferences. Previously, she was in private practice, providing speech-language pathology services and continuing-education seminars for speech-language pathologists. Miller has lectured extensively on communication and swallowing disorders, specializing in disorders following treatment for head and neck cancer, stroke, and neurological impairments, as well as cognitive-communication disorders within the geriatric population. During a 15-year tenure at Tufts-New England Medical Center (NEMC), including as director of speech-language pathology services, Miller was instrumental in developing speech pathology and swallowing services in the Head & Neck Cancer Center. She was also a member of the Stroke Unit Team, Cleft Palate Team, and the Department of Psychiatry at Tufts-NEMC. She obtained her PhD from Emerson College.

Jing Tan is an assistant professor in the School of Social Work at Bridgewater State University, where she teaches both undergraduate and graduate courses, including Data Analysis/Statistics, Research Methods, and Social Welfare Policy. Her areas of research focus on aging and immigration, racial/ethnic minority elders, and the utilization of health and mental-health services among older populations. Tan has also conducted research on health insurance, minority elders’ and older immigrants’ use of health services, older drivers’ issues, elder care in China, and methodological issues related to research on older adults. She received her PhD in social work from Washington University in St. Louis.

Chien Wen Yu is an assistant professor of marketing and management at Bridgewater State University. A member of the university’s Undergraduate Research Advisory Board from 2011 to 2014, Yu has been involved with several undergraduate research activities, including mentoring summer grant-funded research, UR Abroad, honors theses, and semester-grant-funded directed studies. His research interests are in international marketing, transportation, entrepreneurship, and Asian studies. Yu also has extensive work experience in the public sector and private industry. He began his career with the State of North Carolina Department of Commerce as a senior trade manager for Asia and Latin America. He also worked for Ashland Chemical Company and the Bobcat Corporation. His education includes undergraduate and graduate degrees from Beijing Foreign Studies University, Davidson College, Wake Forest University, and Tarlac State University.

Call for Applications

20th Annual Posters on the Hill
Spring 2016 Washington, DC

Call will open September 2, 2015.

Applications due November 4, 2015.

Nothing more effectively demonstrates the value of undergraduate research than a student participant’s words, work, and stories. In spring 2016, the Council on Undergraduate Research (CUR) will host its annual undergraduate poster session on Capitol Hill. This event will help members of Congress understand the importance of undergraduate research by allowing them to talk directly with the students involved in such studies.

CUR invites undergraduates to submit an abstract of their research that represents any of CUR’s divisions (Arts and Humanities, Biology, Chemistry, Engineering, Geosciences, Health Sciences, Mathematics/Computer Science, Physics/Astronomy, Psychology, and Social Sciences). Directors of undergraduate research, faculty members, and other involved administrators are urged to encourage their students to submit posters.
Connecting Business and STEM Education Through Undergraduate Research

Business is inherently interdisciplinary. The practices, policies, and norms that govern business are grounded in social science, and the goods and services that businesses produce are themselves the fruits of science, engineering, arts, and humanities. Business also plays an essential role in translating advances in the arts and sciences into public benefits and shaping humanity’s impact on our planet. Thus, it is increasingly being recognized that business education also must be interdisciplinary to meet the needs of today’s businesses (Colby et al. 2011; Hardy and Everett 2013; Shulman 2011).

This interdependency is particularly apparent for the sciences, which depend on for-profit and non-profit businesses to translate insights and inventions arising from scientific research into products and services that are of value to the public. Indeed, there is an extensive literature on industry’s growing need for a workforce of professionals in the fields of science, technology, engineering, and mathematics (STEM) who have the interdisciplinary technical, social, and business skills required to work productively in a business environment (PKAL 2006; PCAST 2012; NAS 2007; NAE 2002). The emergence of the professional science master’s (PSM) degree programs, for example, is specifically aimed at meeting this need (NRC 2008).

It is also recognized that there is a growing need for business professionals who are capable of integrating science and technology into corporate strategies and management (McCann 2006; Ledley and Holt 2014; Ledley and Oches 2013; Ledley 2012). Benchmarking studies of technology management suggest that CEOs and business-unit managers are often directly responsible for decisions regarding technology, research, and development (Lichtenthaler 2003; Elder, Meyer-Krahmer, and Reger 2002). Research suggests that to function effectively in such corporate roles, business leaders must have: (1) an interdisciplinary knowledge of science and technology, which has been described as “a sophisticated appreciation of their nature, as well as of their economic, social, and ethical consequences” (McCann 2006); (2) the ability to “understand the technical issues facing their organizations and the portfolio of ideas and projects that are in the pipeline at any time” (Harvard Business Essentials 2003); and (3) “technology-centered knowledge” related to the nature of science and technology, the strategic role of technology in business, the implementation of technology, and the process of technological innovation (IAMOT 2007; Mallick and Chaudhury 2000).

In other articles, we have addressed the role of the undergraduate science curriculum in providing business students with the interdisciplinary skills to function effectively in a technology-intensive business environment (Ledley 2012; Ledley and Holt 2014; Ledley and Oches 2013). While most business majors take “introductory” science as part of their general-education requirements (Ledley 2012), these traditional science courses for non-majors often provide little context for applying scientific learning outside of the particular discipline. Moreover, such courses are classically “introductory” in nature, even though for most business students, they represent their last formal experience with science education (Labov 2004). We have proposed that interdisciplinary education might be advanced both by developing undergraduate science courses with pedagogy and learning objectives designed explicitly for business students (Ledley 2012; Ledley and Oches 2013), and also by the reciprocal integration of business principles into science courses by utilizing teaching modules and case studies that contextualize scientific principles within a business curriculum (Szymanski et al. unpublished).

Here we describe the use of undergraduate research to foster interdisciplinary STEM and business learning at a “business university.” Our program differs from other undergraduate STEM programs in that the primary goal of undergraduate research is not to promote STEM careers or graduate study, but rather to highlight connections among STEM enterprises, business, and society. We describe our experience at Bentley University, where more than 95 percent of our students major in a business discipline. Bentley provides a living laboratory for studying how to advance STEM education for business students in general. We describe three different models for undergraduate research: (1) engaging business students in disciplinary STEM research; (2) engaging business students in STEM research connected to service; and (3) engaging business students in the integration of science and industry. Additionally, we address what business students bring to undergraduate research in terms of attitudes and learning styles that may be particularly conducive to informal science learning, and we consider how undergraduate research can help business students achieve the higher goals of liberal education.
The Bentley Business Curriculum

The business curriculum at Bentley is highly structured and includes several components: a disciplinary major of eight to 12 courses (24–36 credits), a “general business” core requirement of nine specific courses (27 credits), and a general-education requirement of 15 courses in different disciplines of the arts and sciences (46 credits). The curriculum is designed in accordance with the accreditation standards of the American Association of Collegiate Schools of Business (AACSB 2012). Throughout the curriculum, there is an emphasis on the “fusion” of business and the arts and sciences (Hardy and Everett 2013). This is evident in the integration of liberal-learning objectives—as exemplified by the Liberal Education America’s Promise (LEAP) Essential Learning Outcomes (NLCLEAP 2011)—into our business curriculum and the integration of business and work perspectives into the arts-and-science curriculum. Bentley University also has a long tradition of engaging business students in service learning and civic engagement, described in numerous publications (Zlotkowski 1996; Salimbene et al. 2005; Szymanski, Hadlock, and Zlotkowski 2012).

Bentley students are required to take one laboratory-based science course and one elective in either math or science, somewhat fewer courses than the average requirement of two laboratory-science courses common among business programs in BusinessWeek’s “top 50” (Ledley 2012). Bentley did not offer a science major until 2013, although approximately 60 students a year graduate with a second liberal studies major in Earth, Environment, and Global Sustainability or in Health and Industry. These complementary majors generally require four to five science courses (including psychology).

Given a highly structured curriculum and a limited number of students enrolled in science-based programs, we identified undergraduate research as an important opportunity for engaging students in additional STEM learning added to their business curriculum. We have taken a broad approach to undergraduate research in STEM fields, building on the strength of our faculty’s disciplinary research, civic engagement, and the work of our Center for Integration of Science and Industry (described below).

UR for Business Students: Three Models

Undergraduate research is not a monolithic enterprise, but refers broadly to engaging undergraduates in inquiry or investigative projects to establish facts or create new knowledge (Wenzel 1997), in conjunction with the scholarly activities of the university’s faculty. At Bentley University, we have developed three different formats for undergraduate research: STEM research with science faculty, STEM research embedded in class-based projects and service learning, and research focused explicitly on integrating science and business to advance translational science.

While very few of our students will pursue STEM careers or graduate study, many will work in science- and technology-intensive industries. Our internal studies suggest that, while students who choose a business university express little interest in becoming scientists, most are interested in science and its promise. Thus our undergraduate research initiatives are designed to promote this interest and the interdisciplinary literacy and facility with science that will be increasingly required in business careers.

Engaging business students in disciplinary STEM research

Faculty in Bentley’s Department of Natural and Applied Sciences have active research programs in fields ranging from climate change, green chemistry, environmental chemistry, and sustainability, to malaria control, epidemiology, health communications, healthcare practices, and drug development. As at other academic institutions of our scale, undergraduates are actively recruited to work in the department and contribute to faculty members’ research. Recent projects that have engaged undergraduates have included field studies to collect sediments and fossils for climate research and the physicochemical analysis of those samples; watershed-scale environmental studies; construction of numerical models of infectious diseases; and enzyme-catalyzed synthesis of polymers. Several students have presented their work at national meetings and have been recognized as coauthors of resulting publications.

Bentley student, Thomas J. Klement, ‘16, synthesizes nontoxic flame-retardant polymers utilizing green chemistry techniques.

Students often express some reluctance to engage in scientific research, feeling that they are outsiders to the culture of a science department and do not have adequate technical skills. Those feelings often disappear as they receive faculty
mentoring that helps them acquire essential laboratory skills and that encourages them to engage in both the excitement of scientific discoveries and analysis of their economic or social impacts. This mentoring also creates an environment in which students recognize that they are essential members of a research team, which in turn encourages them to become actively involved in their own learning.

Several characteristic elements of business education at Bentley can be translated into the research environment. First, the strong focus on group work and the social dynamics of teams in the business curriculum help students become effective members of the research team. Second, the widespread use of case studies as a pedagogical tool prepares students with analytical and problem-solving skills, decision-making scenarios, and the ability to work with ambiguities (Dunne and Brooks 2004) that are often directly relevant in a research environment. Finally, the business orientation and goals of our students often lead them to creative insights into how their research might be translated into commercially successful products and services.

Engaging business students in STEM research connected to service

Engaging students in undergraduate research in the context of providing service to the broader community provides a powerful opportunity to enhance students’ understanding about the links among STEM fields, business, and society.

Primary research centered on a public problem can place STEM and business issues into a civic context and lead students to generate specific recommendations for policymakers at the local, state, or federal levels (Szymanski, Hadlock, and Zlotkowski 2012). At Bentley, for example, students taking a seminar on the science in environmental policy have addressed issues related to federal energy and environmental policies in a service-learning project by conducting primary research for a nonprofit organization in Washington, D.C. At the end of a semester of research, students traveled to Capitol Hill to present their recommendations to lawmakers. As described by Szymanski, Hadlock, and Zlotkowski (2012), initial efforts to help students provide lawmakers with data-driven and pragmatic policy recommendations have been highly successful in terms of impact, pedagogy, and what Colby et al. (2011) describe as the reflective exploration of meaning.

In a recent offering of the same seminar course described above (Szymanski, Hadlock, and Zlotkowski 2012), a student team worked with several D.C.-based nonprofit organizations to study the impact of consumers’ energy literacy on U.S. workforce development and consumer spending. Drawing on disciplinary studies in STEM, accounting, and economic fields, one student initiated a subsequent research partnership with National Grid—a multinational electric-

ity and gas utility—to study how increased energy literacy among consumers may save individuals and the nation money. Still in progress, this econometric study has yielded more than 3,500 data points that link energy literacy with energy consumption. Undergraduate research that identifies society as a stakeholder applies core concepts from both science and business and provides students with a new sense of empowerment in civic affairs.

Engaging business students in the integration of science and industry

Bentley’s Center for Integration of Science and Industry researches the path by which scientific insights and inventions are translated into public value in the form of new products and services that meet personal and public needs, as well as jobs and sustainable economic growth. An extensive body of business research suggests that translational science requires a critical synergy between the potential of new technologies at any point in time, and the business models that provide the resources, processes, and values required for successful development and dissemination of the product (Christensen and Raynor 2003). Thus, the center’s research requires scientific and technological knowledge, as well as knowledge of corporate finance, accounting, markets, strategy, business development, and management.

The interdisciplinary perspectives that underlie the Center’s work are achieved by incorporating undergraduate business students into research teams that include post-doctoral scientists with PhDs in STEM disciplines, along with “executives in residence” from the biotechnology and investment communities. The students’ role on these teams mirrors the role of business professionals in industry whose training in investment, finance, management, strategy, and markets must
complement the insights into technologies provided by PhD scientists, in order to advance translational science. For example, undergraduate researchers have conducted research examining: the relationship between capital investments in biotechnology companies developing gene therapies and the characteristics of each company’s core technology; the relationship between the maturity of biotechnology companies’ core technologies at the time of their initial public offering (IPO) and the company’s performance and success in product development over the ensuing 10 years; and the relationship among funding for cancer research, the measured rate of progress of cancer research, and the number of approved anticancer drugs.

In these projects, students have applied their business education to analyze data on capital investments, corporate valuations, business models and transactions, and product pipelines, while at the same time learning about discoveries at the forefront of science, how science progresses, what it costs, and why it succeeds or fails. They learn the importance of interdisciplinary knowledge in technology-intensive industries, and the discipline required to perform professional-quality business analysis. Students often contribute substantive insights into the asynchronies between technological maturation and investment activity that may delay the translation of promising technologies into new products, as well as business strategies and policies that might accelerate this translation. Through their work at the center, most students earn co-authorship on the center’s publications.

Our initial view of the value of this integrative program comes from an informal, interview-based assessment of our undergraduate research program performed by the executives in residence for the foundation that funds the center. These unstructured interviews with all of the students working with the center suggest that one of the most valuable parts of the experience is the opportunity to interact with the scientific and business professionals on our research teams. Many students also comment on the challenge of applying the lessons from their business courses to “real world” tests, the value of the inquiry, and the quantitative analytical skills that are acquired during their projects. Many students also detail how the experience contributed to their success in obtaining internships and in job interviews.

**Learning Styles, Curricular Fusion**

Historically, students at business universities perceive the arts-and-sciences curriculum or general-education core as hoops that they have to jump through, unconnected to their goal of studying business. Curricula at business universities have been presented as silos of general education, the business core and the major, with unfortunate consequences. Two significant motivating factors for business students are future employment and relevance of theory to practice (Goorha and Mohan 2010; Von Der Heidt and Lamberton 2011). Until recently, business universities neglected to demonstrate a relationship between the arts-and-sciences curriculum and the professional life of someone in business. The importance of developing knowledge regarding the interrelationship of disciplines was even more poorly communicated to business students seeking pragmatic relevance and utility for their learning. This may have been especially true for science education, where the familiar student refrain was, “Why do I have to learn this? I will never use it.”

Research by cognitive psychologists on undergraduates’ attitudes, learning styles, and preferred pedagogies has increased six-fold over the past forty years (Armstrong, Cools, and Sadler-Smith 2012). While there is evidence of some degree of learning-style preferences and attitudes among business students, there may be other factors influencing student attitudes toward science research. It may not be that business students dislike science curricula due to attitudes or learning styles. Rather, institutional culture, explicit messaging regarding curricular relevance to career, and practical application of theory to contemporary problems may be more significant motivating factors.

Kolb’s (1984) Learning Styles Inventory (LSI) is among the most frequent taxonomy applied to students in undergraduate business programs. The LSI includes four learning styles. First, the *diverging style* is characterized by students who prefer information presented from various points of view. The *assimilating style* describes students who prefer to convert disparate information into a coherent whole. Students possessing the *convergent style* seek to find practical utility for theoretical concepts. Finally, the *accommodating style* describes students who prefer to learn by doing.
Business undergraduates possess characteristics of each of Kolb’s four learning styles (Kolb and Kolb 2005). “Business students learn by reflecting on a concept and making observations, abstractly conceptualizing the concept by drawing on these reflections, and by applying the concept through experimentation” (Goorha and Mohan 2010, 148). Fortunately, these are the skills and learning styles necessary for successful and fulfilling undergraduate science research.

The degree to which the pedagogy for undergraduate research in STEM fields is aligned with the institutional culture and with the broader learning experiences of students across disciplines will influence the attitudes students develop toward science education. Thus Bentley University has transformed its intellectual culture in the sciences, abandoning the historical silo model to stress interdisciplinary perspectives and ultimately producing a model of fusion between arts-and-sciences and business curricula. The current model emphasizes the value of transdisciplinary perspectives in addressing the complex challenges that confront business and society. Bentley students are engaged collaboratively in applying theory to practice in simulations from business laboratories to science labs. Service learning, capstone projects for the honors program or liberal studies major, and undergraduate research each provide students with opportunities to apply theoretical perspectives gained in the classroom to real-world social and policy issues.

Bentley has infused experiential learning and faculty mentoring throughout the curriculum. The pedagogical models for undergraduate STEM research are integrated and consistent with this emerging Bentley culture. Through these models, students have developed a deeper appreciation of the relevance of STEM education to business and society.

Of course, applying classroom learning outside of any individual discipline requires an understanding of the application of scientific knowledge, and also a sense of the transdisciplinary nature of complex problems (Szymanski et al. unpublished). For example, addressing problems of global economic and environmental sustainability requires changing the way we educate both STEM and non-STEM majors to think about their roles in the complex systems of commerce, technology, and civic life (Hardy and Everett 2013; Ledley and Oches 2013). These systems can only be understood in a transdisciplinary context that blends concepts from different disciplines and then demonstrates how they can be integrated to contextualize complex problems. Industry is pleading for this kind of STEM literacy (Szymanski 2013; NRC 2014). Practically, this means liberal learning, professional education, and civic engagement must be de-compartmentalized to help students comprehend, if not solve, some of the most pressing issues of society. This fusion of liberal education and business education is what Lee Shulman (2011) calls “reciprocal integration” in his foreword to the Carnegie Foundation for the Advancement of Teaching’s report “Rethinking Undergraduate Business Education” (Colby et al. 2011). Undergraduate research provides many business students with their first exposure to the complexity of the reciprocal integration that is required to solve real-world challenges.

In addition to practical reasoning—the essence of professional education that links knowledge with practice—Anne Colby and her colleagues point to three kinds of liberal learning that are essential to reciprocal integration: analytical thinking, multiple framing, and reflective exploration of meaning. Each of these elements is embodied in the undergraduate research experience, in which students are asked to engage outside of disciplinary reasoning and habits-of-mind, engage in the analytical process of science, and explore the connections among science, industry, and society.

Finally, undergraduate STEM research, particularly in conjunction with service learning or working to accelerate the translation of scientific advances into public value, can empower students to help address critical public issues at a variety of levels. In these cases, service learning challenges students to ask, “What difference does a particular understanding or approach to things make to who I am, how I engage the world, and what it is reasonable for me to imagine and hope?” (Colby et al. 2011).

Implications

In this article, we describe the use of undergraduate research to integrate STEM learning into a structured business program. Building on existing strengths in science research, civic engagement, and Bentley’s Center for Integration of Science and Industry, we have explored three distinct avenues to introduce business students to scientific inquiry and discovery. These models include projects designed to (1) engage business students in disciplinary STEM research; (2) engage business students in STEM research connected to service; and (3) engage business students in the integration of science and industry. These pedagogical models are integrated and consistent with an emerging culture of fusion between experiential learning and faculty mentoring at Bentley. In our experience, business students are eager to integrate science into their business careers, become highly engaged with their research mentors, and bring valuable skills to research teams trying to integrate research outcomes, business practices, and societal value. Many earn co-authorship on academic publications and present at professional meetings. As a result, the students believe their research experiences extend both their business and scientific skills and ultimately contribute directly to their success in internships, job inter-
views, and emerging business careers. Like the professional science master’s degree, undergraduate research connecting science and business can help provide future business leaders with the interdisciplinary skills that they, and their businesses, need to succeed.

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Growth of an Engineering Department with Undergraduate Research

Drawing on more than a decade of research literature discussing the broad benefits of undergraduate research for students, the Department of Macromolecular Science and Engineering at Case Western Reserve University increased the number of its undergraduate majors over a ten-year period by incorporating research into the curriculum for the major. Our experience revealed many of the same benefits for students discussed in the previous literature, and also demonstrated the importance of many of the principles and approaches outlined in CUR’s Characteristics of Excellence in Undergraduate Research (COEUR) (Hensel 2012).

Undergraduate research has been identified as a high-impact educational practice, and many positive student outcomes have been associated with it, including greater student retention in the STEM (science, technology, engineering, and mathematics) fields, better student persistence to graduation, and higher rates of enrollment in graduate school (Brownell and Swaner 2010; Griffith and Kaya 2013; Kuh 2008; Laursen, Seymour and Hunter 2012).

The Department of Macromolecular Science & Engineering (Macro) was established at Case Western Reserve University in 1963 as the first stand-alone department for polymer education and research in the nation. Initially a graduate program only, a BS in polymer science and engineering was added a decade later. Throughout the 1970s and 1980, four-year enrollments of between 20 and 50 undergraduates were common. The numbers slowly declined until in the fall of 2002 only three students were seeking the undergraduate degree.

How could such a decline have occurred? After aggressive faculty hiring and little turnover for 20 years, the faculty in 2002 was composed of very senior individuals intensively focused on their own research and graduate students. Given that polymer science and engineering is not a widely offered college major, high-school guidance counselors were often unacquainted with the field, and few students came to Case Western intending to pursue the major. Further, little effort was made by the faculty to capture their attention once they arrived on campus.

Why should we care? The polymer industry is a major area of employment in the U.S. In fact, more than half of all Americans who graduate with majors in chemistry and chemical engineering work in this field. The genesis of this particular department over 50 years ago stems from the CEO of Dow Chemical, who challenged his alma mater to train students in the growing polymer field. In Ohio, approximately 1,800 companies work in the polymer sector, making it the second largest area of employment, after agriculture. As important as the polymer field is to the U.S. economy, few chemistry and chemical-engineering departments offer even a single polymer course to their students, leaving much specific training to the companies that hire their students. The more than 1,800 graduate and undergraduate alumni of the “Macro” department therefore have entered their field of employment with a significant advantage over students trained in more traditional disciplines.

Integrating Undergraduate Research into the Curriculum

What has changed? New faculty joined the department in academic years 2000, 2001, and 2002. They were surprised and dissatisfied to be teaching classes that often enrolled just three or four undergraduates. Through a series of lunch meetings, these new faculty members devised a plan to address the low enrollments. Step one was creation of a new one-credit course, Freshman Research in Polymer Science, that met for six hours a week and was coordinated by one of the new faculty members, Associate Professor David Schiraldi, who had joined the department after working for two decades in the polymer industry. The course placed first-year students into the laboratories of the newer faculty members, allowing them to work on cutting-edge projects under the guidance of PhD students.

Several years earlier, the Boyer Commission on Educating Undergraduates in the Research University (1998) had been set up to improve undergraduate education at research-intensive universities. Its first recommendation was to connect students to what the faculty at those institutions were passionate about—their research. Case Western Reserve is a research-intensive university, and the new one-credit course proved attractive to three freshmen during the fall semester 2003. They talked to their friends, so another six students enrolled in the spring 2004 term. Four of those nine initial students became Macro majors, doubling undergraduate enrollment in the department.

That success led to several important next steps. The three participating faculty members convinced other research-active colleagues to accept students from the freshman-research course in their research groups, thus increasing the course’s...
capacity. The department worked closely with the Office of Undergraduate Admission and the undergraduate-research office to inform entering students interested in engineering or chemistry about the first-year research class. In addition, the department strategically placed some of its most charismatic faculty as instructors for first- and second-semester engineering classes, including a 200+ freshman-level introduction to materials course taught each fall. The department continues to do this.

In the second important step, at the request of the new Macro majors, a sophomore/junior year research course was created that expanded the scope of projects in which students could become involved. The course could carry from one to three credits, translating to expectations for 6, 10, or 14 hours per week in the laboratory, which corresponds to university-wide workloads for more traditional lab courses. The specific program objectives for the research courses, known as EMAC 125 and 325, are outlined in Table 1.

Table 1. Specific Program Objectives for EMAC 125 and 325 Courses

- Introduce first-year students to the (generally unknown) field of polymer science & engineering
- Introduce first-year students to the methodologies of laboratory research
- Connect hands-on science/engineering experiences to classroom coursework in the first year of university studies
- For those continuing in the polymer field (majors and minors), provide a continuing connection between coursework and hands-on research activities, reinforcing fundamental concepts and instrumental methods
- Provide a strong background in research for participating students, which in turn enables them to compete effectively for external research activities (summer REU programs, corporate internships) and thus supports graduate-school applications and STEM research careers
- Create opportunities for PhD student mentors of undergraduate researchers to develop their teaching and advising skills.

The third step allowed students who took the undergraduate research courses to use them to fulfill one or two of their required technical electives within the major, offering a more experiential approach to learning their field of specialization within engineering. All Macro majors also are required to carry out one or two semesters of thesis research within the department as seniors, so depending on their specific interests, Macro majors can incorporate from one to eight semesters of research into their undergraduate plan. The average for Macro majors over the past six years has been approximately three years of undergraduate research per student.

Thus it should not be surprising that nearly 75 percent of these students have gone on to PhD programs after graduating from Case Western Reserve, which supports the previous findings of Hathaway, Naga and Gregerman (2002).

As more faculty slots turned over, dedication to undergraduates and undergraduate research become a critical hiring criterion for the department’s new faculty members, further increasing the number of students served. Addition of an adjunct faculty member, retired from a local polymer company and focused entirely on mentoring freshman researchers, also helped allow the enrollment of an average of 22 students per semester in the freshman research course, with about 40 percent of those students becoming Macro majors. As Griffith and Kaya (2013) and Laursen, Seymour and Hunter (2012) note, students desire an early research experience, which, when favorable, predisposes them to continue with research.

Summer Undergraduate Research

Research experiences for undergraduates within the Department of Macromolecular Science and Engineering are not limited to the academic year and may involve students from beyond the university. The summer of 2004 served as the first of twelve consecutive years of summer undergraduate research, with the first small cadre of students having completed the freshman-year research course continuing into summer. This successful pilot led to two NSF REU (Research Experience for Undergraduates) grants and other funding from an NSF Science and Technology Center grant. These external funds were used exclusively to bring students from outside Case Western Reserve to our campus in Cleveland for the summer, with experiences modeled after the sophomore/junior-level research course, but for 40 hours per week.

As is true for most all NSF REU site programs (Beninson, Koski, Villa, Faram and O’Connor 2011), the majority of external summer research participants have come from primarily undergraduate and from minority-serving institutions. While expanding the educational horizons for these students, the NSF REU site program provided an excellent opportunity for the Macro department to recruit a diverse group of American students into its PhD program who had already demonstrated their research capabilities. Over the past twelve years, the number of PhD students in the department has grown to 78 in the fall of 2014, with representation of African Americans within the doctoral program increasing steadily from none to the current 12 percent. This matches the proportion of African Americans in the U.S. population and is triple their current average national representation within graduate engineering departments. This growth of diversity within the Macro graduate population is a direct consequence of the inclusion of underrepresented minority students in the summer undergraduate research program.
In addition to the non-Case Western Reserve summer students, the department and its faculty typically have found funding for four to six of their own students within the cadre of summer students. These students provide leadership and local knowledge of both the physical campus and of the research subject areas. They are supportive of the department (serving as effective recruiters of future PhD students), and they are housed with the non-Case Western students in a single residence hall each summer.

Our faculty mentors also help Macro undergraduates find external summer research opportunities. With 75 percent of Macro undergraduates typically matriculating directly into graduate programs, summer research provides them a means of seeing other potential graduate schools. Macro graduates have attended summer REU programs ranging from the University of Arizona and Washington State University, to Northwestern University, Georgia Tech, the University of Massachusetts, and Virginia Tech.

Research Abroad, Other Opportunities

Undergraduate research abroad took root in the Macro department five years ago, as an outgrowth of author Schiraldi’s sabbatical in Barcelona, Spain. The following summer, and every summer since, two Macro undergraduates have been sent for 10 to 12 weeks of research in Spain. Other students have done research in Switzerland, Germany, France and China as individual faculty members have used their international collaborations to create opportunities for undergraduates working within their research groups. Research grants or a small department endowment are used to provide airfare and a stipend to students participating in international summer research. With the continued growth in overall undergraduate enrollment within the department, the number of these opportunities offered each year is increasing steadily; it is now commonplace to include a line item for such support in grant proposals. Students who work with international collaborators of Macro faculty can, and have, served as vectors for translating research between locations, enhancing the richness of both education and research for all parties.

A consequence of expanded undergraduate research is the opportunity for publication and presentation of that work. A steady stream of undergraduates has travelled around the country to present their work in poster form at scientific conferences, most notably at the national meetings of the American Chemical Society, whose spring meeting is ideally suited to the academic year. As students make important contributions to their research, co-authorship, typically with their graduate mentor and faculty advisor, frequently results in and increasingly is necessary for students wishing to be accepted into the nation’s most selective PhD programs. At one point recently, five Macro graduates were pursuing doctoral degrees at the Massachusetts Institute of Technology (in chemistry, chemical engineering, material science, and mechanical engineering) illustrating the broad impact that an interdisciplinary education can have.

Resulting Costs and Benefits to Faculty

More than ten years after the first freshman-research course was offered, many Macro professors recognize the tension in undergraduate research outlined by Laursen, Seymour and Hunter (2012) who wrote, “Undergraduate research is one of many educational innovations that are good for students but hard on faculty” (37). Prior to integrating undergraduate research into the curriculum, the faculty focus was primarily on graduate students, as noted above. Faculty contact with undergraduates was limited to the classroom and office hours. Today, the highly research-oriented undergraduate curriculum, coupled with growth in undergraduate enrollment, has placed demands and stresses on research-active faculty. These demands include:

- additional work in identifying, supporting, and mentoring these less-mature students;
- increased financial burdens stemming from the need to continuously support and expand undergraduate research opportunities due to increasing undergraduate enrollments;
- the potential for reduced focus and productivity among PhD students who also mentor undergraduate researchers; and
- time constraints.

Beyond their work with graduate students, faculty members now frequently have research meetings with undergraduates, working with them to identify appropriate projects. The projects of undergraduate and graduate students often are integrated, especially as undergraduates progress through the curriculum. Graduate students can gain valuable mentoring experiences that help them develop their own teaching and advising skills. Finally, over time undergraduate researchers learn to become “productive,” serving as a low-cost source of research results, helping to balance the investment of faculty time and financial resources needed to support the research-oriented undergraduate curriculum.

Conclusion

Exposure to motivated faculty in the classroom, coupled with the hands-on research opportunities discussed above, have served to expand and sustain enrollment in the bachelor’s degree in polymer science and engineering (see Figure 1). At the same time, students have experienced the same types of significant outcomes that have been written about during the past decade (Kuh 2008).
In 2012, the Council on Undergraduate Research (CUR) published its *Characteristics of Excellence in Undergraduate Research (COEUR)* (Hensel), which described a number of principles and approaches to successful UR programs. Looking back over the ten-plus years of expanding the undergraduate polymer program at Case Western Reserve by integrating undergraduate research into the curriculum and expanding undergraduate-research opportunities in general, one can identify readily many of the characteristics cited in the CUR publication. For example, in Section 9 of the COEUR document, curriculum is identified as one of the characteristics. It is clear that the faculty in the Macro department at Case Western Reserve were willing to design and even center the undergraduate curriculum on undergraduate research. The faculty developed undergraduate course credit beginning with the first year and also made undergraduate research a requirement for students in the Macro major. Another example is in Section 10 of the COEUR document, which identifies developing summer research programs as another characteristic of excellence in undergraduate research. The Macro department at Case Western Reserve has had, since summer 2003, a summer research program. Both students from Case Western Reserve and elsewhere have participated. Many of these students have gone on to graduate school at the university and elsewhere. The successful outcomes one can see in 2015 from the decisions that several faculty made in 2002, and the work they have done since that time, reinforce the evidence that undergraduate research has the potential, as the Boyer Commission desired in 1998, to help strengthen undergraduate education at research-intensive universities.

**References**


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Sheila Pedigo has been the director of the undergraduate research office at Case Western Reserve University since its inception in 2004. She earned her bachelor’s degree at Belmont University and both her master’s in counseling and her doctoral degree in educational policy and leadership from the University of Kansas.
From the International Desk

Integrating Research and Professional Learning—Australian Capstones

In 1998 the Boyer Commission recommended that all undergraduate programs in the U.S. should culminate with a capstone experience and that “the final semester should focus on a major project and utilize to the full the research and communication skills learned in the previous years” (1998, 27). Capstones or senior seminars are now relatively common in the U.S., with increasing numbers implemented since the 1980s (Hauhart and Grahe 2015). Hauhart and Grahe indicate that capstone courses are offered at 70 to 80 percent of U.S. higher-education institutions, most commonly at smaller private institutions. The research focus of many capstones is evident in the literature. Schermer and Gray (2012) suggest that capstones are characterized by independent but guided research experiences, while Hauhart and Grahe (2015) argue that the most successful capstones consist of a research project and that students who undertake “research-based capstones have positive experiences and develop cognitive and practical skills that students who do not engage in a research experience do not develop” (5). They further argue that research-based capstones dominate in many disciplines, particularly in the social and natural sciences and humanities (8).

In Australia, there has also been substantial and growing interest in the role of undergraduate research (Brew 2010) and the final-year experience, including capstones (van Acker et al. 2013). However, this is contested ground. In the Australian context, as elsewhere, institutions of higher education have recently been subject to a great deal of criticism that focuses on the need for vocational, rather than research-oriented, curricula. Much of this debate has focused on the role of higher education as a contributor to the national economy (Commonwealth of Australia 2014a; Hout 2012; Norton 2012). Confronted with high numbers of youth who are neither employed nor undertaking education, international development bodies are also questioning the role of education systems in improving employment rates, citing a need for better alignment of higher-education curricula with labor-market needs. A report on improving youth outcomes from the recent G20 summit concluded that, “Preparing youth for the labour market is one of the key functions of the education system” (International Labour Organization and Organisation for Economic Co-operation and Development 2014, 11).

These arguments can be polarizing, leading to negative comparisons between professional and research outcomes and “academic” becoming synonymous with “irrelevant.” The emotional nature of the debate in Australia has created pressure on universities to justify the undergraduate curriculum in terms of its capacity to develop students who are work-ready, and to justify the place of the university as a contributor to national economic success rather than to individual development or social good (Green 2014). The stakes in these arguments are high. In Australia, media and government reports regarding return on investment (Norton 2012) have also been woven into justifications for reduced government funding to universities (Commonwealth of Australia 2014b).

In Australia, it has become clear that students do not generally believe that their undergraduate degree has prepared them for employment. The results of the 2012 Australasian Survey of Student Engagement (ASSE) show that only 33.5 percent of graduates in later years believed their college experiences had contributed very much to their development of work-related knowledge and skills. Only 26.4 percent felt strongly that their studies prepared them to work effectively with others, and just 25.2 percent felt their studies contributed significantly to their ability to solve complex, real-world problems (ACER 2012). Given that most students undertake a degree as the first step in a career, those statistics have further heightened concerns about the quality and purpose of undergraduate education.

As a result, universities in Australia have made significant efforts over recent years to develop a range of curricula and

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*Disciplines were mapped to the eight identified in the Learning and Teaching Academic Standards (LTAS) exercise (see http://www.olt.gov.au/standards/FAQs).

One participant did not list a discipline.

Non-Discipline / Interdisciplinary capstones were not focused on any discipline and accepted students from all disciplines.*
co-curricular opportunities for students to engage with industry and develop job-seeking skills. Nonetheless, the notion of professional or workforce preparation at times sits uncomfortably with the broader role of universities in developing students’ capacity to challenge accepted worldviews and to act as change agents through knowledge production and critique—and the role of research as a stimulus for those skills.

Historically, this division can be seen most clearly in the separation of research degrees from undergraduate and postgraduate coursework degrees. As a result, there have been numerous moves to integrate coursework and research programs either through embedding coursework in research programs or embedding research in coursework programs (Bradley et al. 2008). However, a push for the integration of research and industry with undergraduate academic curricula is more complex, with rapid shifts in policy—from a research-teaching nexus to work-integrated learning—posing challenges for sustaining systemic improvements (Brew and Cahir 2014). Certainly, undergraduates’ engagement with research has remained patchy and largely discipline-dependent, as has the integration of professional skills and contexts with academic coursework.

The complexity of this task for faculty should not be underestimated, nor should the differences among disciplines. In newer fields (to higher education), research may not have played a strong part in the educational or work experiences of faculty, and it may still not be considered an important component of undergraduate education by industry. For example, business and para-professional fields typically require graduates to have high-level and wide-ranging work-based competencies and knowledge, with research capacity less emphasized. Hauhart and Grahe (2015, 7) also point to differences in disciplinary priorities, particularly in the performance arts, where training for performance is intensive and often takes the place of more traditional forms of academic research. In other fields, the difficulty may be in identifying how industry might play a part in what has traditionally been an environment of deep engagement with issues of humanity, such as the disciplines of philosophy and politics. Further, in many disciplines, there is an ongoing debate about what we might consider to be valid research activity, leading to confusion about what a research-enhanced and professionally relevant curriculum might look like.

In addition, an obvious and often-articulated challenge lies in a crowded curriculum and the competing needs for depth and breadth. How do we build in the knowledge, skills, and attributes of the exceptional thinker and researcher and at the same time develop the exceptional industry professional in an already overloaded and content-heavy curriculum? Combining standard academic learning-and-teaching practice with equal measures of research capacity-building and industry experiences is not a simple task.

### Capstones in the Australian Context

While capstones vary substantially in scope and format, a broad definition is possible. In the simplest terms, capstones are substantial, culminating learning experiences that take place in the final stage of an educational program, offering closure and a focus for the sense of achievement that comes...
with completing a degree. Many authors describe characteristic features of the capstone experience as the synthesis and application of prior learning. It is broadly agreed that capstones involve students in authentic and complex problems requiring an increased level of independence and decision-making (Healey et al. 2013; van Acker et al. 2014; Weimer 2013).

Much like the American capstone, the Australian capstone has typically been described as a culmination of disciplinary coursework—required to ensure that students are able to synthesize prior learning. In Australia, capstones are most often described as having a professional focus, providing an opportunity for students to “both look back on their undergraduate study in an effort to make sense of what they have accomplished, and to look forward to a professional existence where they can build on that foundation.” (McNamara et al. 2012). This concern with work-readiness is present in much of the Australian literature. Multiple authors have argued directly or indirectly that capstones should be concerned with the enhancement of work-readiness and the transition to work (Keller, Parker, and Chan 2011; Holdsworth, Watty, and Davies 2009; Lee 2014). McNamara et al. (2012) further argue that capstones support students in gaining direct and authentic experience in the workplace or in community organizations, which aim to immerse students in their post-graduation career setting. Similar concerns are evident in the UK, with some work under way to make capstone work-relevant (see, for example, Hill et al. 2011).

Nonetheless, there is evidence that numerous capstones involve students undertaking the research activities typical of their fields. Many of these cases can be found on capstone-related project websites and associated reports (For examples see www.capstonecurriculum.com.au; www.businesscapstones.edu.au and the “Rethinking final year projects and dissertations” site at http://insight.glos.ac.uk/cgi/activities/ntf/creativehops/Pages/default.aspx.) In some cases, projects may include approvals from research-ethics boards and/or quantitative data collection and analysis; others may incorporate document or auto-ethnographic research, although in many, the research utilizes secondary, rather than primary, data. Some undergraduate capstones provide students with opportunities for research that can be published in academic journals, moving the work beyond merely “practicing” research skills into work capable of winning academic recognition among peers. (See the Australian National University’s Undergraduate Research Journal, Victoria University’s Offset magazine, and the joint publication of Monash University and the University of Warwick, Reinvention: an International Journal of Undergraduate Research). For many undergraduates, capstones provide the first opportunity to substantially engage in a research culture or at least to be introduced to the concept of doing academic research.

Having students conduct research does not, however, mean forgoing the development of professional workplace skills. We argue that many of the skills and attributes of professionals closely reflect the skills developed through research and inquiry, and we believe that these can be integrated effectively in the curriculum.

**Government Research into Capstones**

In 2013, the Australian Government Office for Learning and Teaching funded a fellowship for author Nicolette Lee to carry out research and development of practical resources for capstones. The fellowship included a substantial analysis of current capstone curricula with a focus on Australian practice. This included in-depth, semi-structured interviews with 13 capstone coordinators, a curriculum-focused survey with 216 respondents, and collection of 14 case studies. The project also included wide engagement with faculty members across Australia, resulting in a network of some 309 capstone coordinators and discussions with 215 capstone faculty at workshops and meetings across the country. (For in-depth details, see the “Australian Capstone Appendix” in CURQ on the Web.)

Together, these activities formed the basis for the development of a comprehensive snapshot of the current status of capstones in Australia, as well as the basis for a range of tools and resources for faculty use. These resources were developed in response to common questions raised by participants in workshops regarding the nature of capstone curricula. One of the most common questions was how capstones might address contemporary pressures involving research and professional outcomes, which we attempt to answer in the following, drawing on the experiences of capstone faculty and some case studies in which research and professional outcomes were successfully integrated.
Survey Findings, Interviews

Many examples of professional and research skills being developed in separate capstones, sometimes within the same degree program, have been recorded (Schoetter and Wendler 2008). In our research mapping capstones in Australia, coordinators from diverse backgrounds favored professionally oriented curricula and learning outcomes more than they did development of research skills (see Table 1). One coordinator of capstones that involve student internships in industry stated that capstones must contain “a series of topics and activities and exercises that force the students to look forward to the industry and ... reflect on their time in industry.” One coordinator said capstones must build evidence of employability and “a career philosophy ... just as academics we’re told we need to have ... a teaching portfolio.” Another argued that capstones are “an opportunity to develop students’ capacity by taking them into the world of the client.” Another said that, most importantly, through the capstone students “actually understand what real work is like.”

These same coordinators positioned what one described as “research project” capstones, even those with minor industry components, as more academically traditional and a poor alternative to achieving work-related learning outcomes. These coordinators viewed such capstones as limited in scope and focus, particularly for integrating prior learning. One coordinator described the risk that work in such capstones “degenerates into the Research Methods 101.”

Other coordinators, however, favored having students conduct what may be considered traditional inquiry and research. One coordinator stated, “I expect them to do substantial research with anything they are doing; they have to have literature reviews and interim reports and have to be up on the latest government and other reports that might be relevant to their work.” These coordinators noted links between some projects and existing staff research projects. Only one coordinator articulated reciprocity between research and professional skills. This coordinator described students in his institution’s industry-focused capstone as having “an inquiry inside their project of some kind.” Another coordinator went on to detail how one goal of the capstone is for students to develop “a reasonable understanding of how their skills, how their academic research work, [and] how their relationships ... integrate into professional practice.”

The survey data also demonstrated that many coordinators see a dichotomy between goals for development of research skills in capstones and goals for development of workforce skills. This separation of research and employability goals was seen in the survey data. Capstone coordinators in the survey were asked to rank the importance of 28 purposes for capstones, derived from the literature (see Table 2). Preparation for industry/employability was ranked higher than preparation to do research overall. Only one respondent in the whole sample ranked industry/employability preparation as not at all important. By contrast 36 participants ranked training for research careers as not at all important.

As noted in Table 3, among respondents it appeared that the more important research training for research careers was ranked, the less important preparation for industry tended to be ranked, and vice versa ($r=-.14, p=.03, n=187$). Disciplinary differences were apparent in these divergent views (see Table 4). In particular, faculty from health and social sciences disciplines ranked research and preparation for postgraduate study the most highly, while faculty from business and engineering disciplines ranked them the lowest. However, faculty in health disciplines also ranked preparation for industry as very important, suggesting that in some disciplines a need is felt to integrate preparation for both research and industry into the capstone experience.

Regardless of whether a capstone was explicitly focused on development of research or work skills, we found consistent descriptions of the skills and attributes that students were expected to develop and demonstrate in their capstones. Across all survey respondents, the purposes of capstones were almost identically weighted regarding personal attributes, professional outcomes, and academic skills and knowledge. The great majority of respondents (85 percent) ranked as very important the ability to do in-depth analysis, apply knowledge to practice, organize and manage work, solve problems creatively, and communicate effectively.

Those attributes and skills are largely developed through projects; the vast majority of our survey respondents reported that their capstones were project-based (89 percent). The nature and scale of the projects varies significantly, from one-semester investigations of a single topic to a full year of complex product development. Some elements of the curriculum are more constant: Projects often include high levels of student autonomy in choices of topic, methods, and outcomes. Participants’ responses from across the disciplines and types of capstones also consistently refer to a curricular and outcome focus on inquiry and generic skills, indicating that there is a common set of expectations in both research-focused and professionally oriented capstones.

Case Studies Combining Inquiry with Professional Outcomes

In our research, case studies provided the most detailed insights into capstones’ structure. Some cases exemplify the successful integration of inquiry and professionally relevant learning outcomes. These cases focus on the development of research skills, while also providing opportunities for community or industry engagement; they also generated outputs that are concrete evidence of a range of transferable skills and capabilities among students. Common elements among many of these cases include use of an applied-inquiry approach that links professionally relevant investigations with more formal academic research skills. These reflect much of the literature on research and inquiry in undergraduate education (for example, Healey 2005; Healey and Jenkins 2009).
Specifically, students identify a topic of interest, undertake an investigation drawing on external expertise and collaborations, analyse data, and present findings and other outputs. The case consist of a major project undertaken with a high degree of independence and choice about the approach and topic, and demonstrate a general pattern of “just-in-time” guidance and support rather than didactic delivery.

Outputs include substantial written reports that incorporate conventions in both professional and academic writing, as well as products arising from or alongside the inquiry process. As importantly, each orients the project work to external audiences through some form of collaboration with industry or community. It is worth noting here that, while in the U.S. community engagement is well tested (Strand et al. 2003), it has been relatively limited in Australian higher-education curricula to date. We include here brief descriptions of some illustrative capstone projects.

**The Graduating Project at Victoria University, Australia.** As noted by Hauhart and Grahe (2015, 8), while research-based capstones are common in the social sciences and humanities, interdisciplinary research-focused capstones are less common. In the Graduating Project at Victoria University in Australia, students from diverse majors such as Asian studies, political science, visual and performing arts, media, and sociology work together in cross-disciplinary teams for a year on a substantial investigation of an issue or problem on a topic of their choice. Students must navigate diverse worldviews, interests, and skills to progress in their work. They identify an issue or problem, to which they then test, refine, and develop responses through collaborations and research with interested external, non-academic partners. Throughout the capstone, students are provided with mentoring, “just-in-time” workshops, and training in research methods.

Interim reports and presentations are used to identify further learning needs, and the final assessment is based on a final report and presentation, as well as on products such as training resources, videos, and books. While the report’s structure is predefined, the student teams define the nature of the products developed, reflecting the highly flexible curricular and assessment regime. The curricular structure operates in such a way that students effectively work as consultant researchers to the external partners, but also engage in a within-team learning process as they come to terms with the disparate views, skills, and knowledge of their team-mates. They develop employability skills through an explicit process for project management and stakeholder engagement. They gain expertise and a broad range of transferable skills, including the capacity to use their skills in “real-world” contexts and in ways that are informed by the needs of their industry and community partners. Detailed information on this capstone approach can be found in Funston and Lee (2014).

**The Music Industry Project at the Royal Melbourne Institute of Technology.** Also noted by Hauhart and Grahe (2015), disciplines such as music often privilege performance skill over development of research capabilities. In the Music Industry Project, we found that both activities are equally weighted and aligned. Each major component (professional and research) is designed to support the other. Specifically, students develop a capstone project aimed at producing a showcase or product related to their individual career goals, such as a performance or recording, documentary, or business plan. The project is accompanied by a written report aligned with their project. This written work supports their project by demonstrating their deepening understanding of relevant topics.

This process is supported by workshops on research methods. In addition, tutorials provide students with support on writing techniques, along with discussions about the nature of challenges in industry and the application of research to that context. Assessment is continuous, with weekly writing and project updates and presentations, thus ensuring that students receive ongoing feedback. Students are encouraged to make use of and extend their industry networks as part of this work, including engagement with industry to refine their research and production work. As a result, students’ projects develop their research capabilities and align these capabilities with areas of professional interest.
The Australasian HealthFusion Team Challenge. Another example of a capstone integrating development of students’ research and professional capabilities but using a substantially different model is the Australasian HealthFusion Team Challenge. In this capstone, students from multiple universities and across the health professions compete in inter-professional teams to develop a comprehensive management plan for a provided case study (Boyce et al. 2009). The process involves students undertaking secondary research, supported by their academic supervisors and professional mentors, culminating in a student team’s presentation of findings and resulting healthcare proposals (a case-management plan) to a panel of professional and academic judges at a regional or national competition. These presentations are accompanied by a detailed report outlining treatment recommendations.

The inter-professional nature of this process deepens students’ understanding of the role of related health professions, as well as testing their understanding of the boundaries and provisional nature of knowledge in sub-disciplines or professions. What emerges from this process is a set of capabilities around structured and dialectical investigation and analysis, professional behaviors, and communication.

Many other examples of the integration of research and professional capabilities can be found in the literature. For example, Julien et al. (2012) describe a capstone in which students in human biosciences carry out research on a topic that prepares them for careers in both industry and research. In more or less explicit terms, other literature discusses cases in which students variously engage with problems in industry using disciplinary research skills (for example, Peterson, Phillips, Bacon, & Machunda 2011) and/or develop creative solutions for trans-disciplinary challenges while explicitly gaining skills in key attributes linked to employability (for example, Reid and Estell, 2010; Siniaowski and Patel 2010).

Conclusion
Despite some academics’ feelings that development of research and professional skills cannot be reconciled during students’ capstones, there is evidence from both Australia and the U.S. that research and professional outcomes can be successfully integrated. The cases identified through our work with capstones in Australia, as described above, exemplify the flexible and ultimately successful combination of components of research/inquiry and professional learning. In each case, there is a common curricular framework of applied research that involves a rigorous identification of problems and needs for information, followed by deep analysis and then presentation of findings and other outputs. Engagement with professionals from industry or community leaders also appears to be a common factor in these cases, providing an additional grounding of the inquiry process through an expectation that students operate as professionals and orient their work in relation to external needs. These cases suggest that integration of academic and external view-points provides students with opportunities to gain the research and inquiry skills that are relevant in both settings. In a contested higher-education context in which “academic” curricula can seem less-than-relevant to graduates’ employability and thus of limited immediate economic value, these are increasingly important considerations for the design of undergraduate capstones.

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Australian Capstone Appendix: Research Methodology
This appendix provides a brief overview of the methodology used in the research supported by the Australian National Senior Teaching Fellowship regarding undergraduate capstones in Australia.

Read more in CURQ on the Web.
What Prevents Business Faculty and Latino Business Students from Participating in Undergraduate Research?

Despite the many advantages of undergraduate research (Nagda et al. 1998; Lopatto 2007; Russell et al. 2007), there are still sizable pools of faculty and students who do not participate as either researchers or mentors. Do the same issues that make undergraduate research difficult for those who do participate also prevent others from even beginning? Or are a different set of barriers involved? To find out, we conducted a qualitative research study that included focus groups and interviews with students and faculty who have not engaged in undergraduate research.

We targeted faculty in the College of Business in a research-intensive institution in the south as well as Latino undergraduate business majors to find out why they chose not to become involved in undergraduate-research programming or individual research projects. Our analysis identified several major reasons for the lack of engagement for both students and faculty. While many of the drawbacks were the same as those cited by people active in undergraduate research, another major barrier for the Latino students surveyed was their lack of understanding of what college-level research is, and therefore their inability to see any benefit for participating. On the part of faculty, we found a near-universal perception that business students in general are not interested in research. These two misconceptions feed into each other with the result that Latino students show little or no interest in undergraduate research, and without highly motivated and engaged students, faculty rarely offer undergraduates research opportunities. Fortunately, our focus-group discussions suggest a relatively simple way to break this unproductive cycle.

What the Literature Says

The benefits of undergraduate research (UR) experiences for students are well established, including greater likelihood of finishing college, better integration into academic and college life, greater confidence in abilities, and a deeper understanding of their major, to name a few advantages (Nagda et al. 1998; Merkel 2003). These benefits are particularly pronounced for under-represented minorities (Nagda et al. 1998; Ishiyama 2007; Russell et al. 2007; Hurtado et al. 2008). Faculty motivations for engagement in UR include mentoring talented young students and contributing to the faculty member’s research projects, as well as fulfillment on a more personal level because of the positive experiences they themselves had as students (Eagan et al. 2011; Webber et al. 2013). Taken together, these benefits suggest that students and faculty in general and Latino students, in particular, would benefit from undergraduate-research programs.

Given the resources available at research universities, it seems reasonable to assume that students at those institutions have many more research opportunities than peers at other institutions. Surprisingly, studies suggest otherwise. Some have found no measureable advantage for a student enrolled at a research university either in obtaining a research opportunity (Hu et al. 2007; Hu et al. 2008) or in learning productivity such as involvement in active learning or amount of faculty contact (Kuh and Hu 2001). A survey of twenty institutions belonging to the Association of American Universities, whose members are top research institutions, showed that even at those institutions, a significant fraction of undergraduates do not participate in UR either as part of a course or as a cocurricular activity with a faculty mentor (Webber et al. 2013). Similarly, not all faculty are interested in being UR mentors (Merkel 2003; Einarson and Clarkberg 2004; Webber et al. 2013). Faculty mentored undergraduate research in business schools (with some exceptions) is much rarer than it is in disciplines and colleges such as engineering or the sciences where a culture of UR is well established (Hu et al. 2008; Douglass and Zhao 2013).

A great deal of research has focused on the difficulties of, and means of improving, student and faculty experiences once students are engaged in UR, but very little is known about why a student or faculty member would not even consider UR to begin with. If the barriers to starting UR are the same as those to thriving in UR, how and why do some disciplines, institutions, and groups of students overcome them and others do not? If the barriers are different, then different solutions may be needed to increase student and faculty participation in particular situations. By examining and comparing faculty and Latino students’ attitudes and perceptions of UR in a program with little UR participation, we hoped to uncover the issues present in this particular “ecosystem” that underlie student and faculty failure to engage in UR.

In this study we asked why most Latino undergraduate business majors fail to undertake UR at a large state research-intensive institution—a situation that mirrors that found at 15 research-intensive universities in another study (Douglass and Zhao 2013). Our first objective was to find out from Latino students why they do not consider undertaking UR. Our second objective was to discover how business faculty...
felt about recruiting and working with undergraduate researchers. Faculty resistance to working with undergraduate students because of their lack of skills, ability, or scholarly sophistication has been previously documented (Kremer and Bringle 1990; Kinkead 2003; McDorman 2004; Ishiyama 2007; Hu et al. 2008). We felt that there might be additional or different factors that prevent business faculty from becoming mentors.

Barriers to Student Involvement

Many studies have established the advantages of UR for student learning and experience by investigating the outcomes of new or established UR programs (reviewed in Page et al. 2004; Crowe and Brakke 2008). Some have specifically looked into the positive effects of the UR experience on minority groups. For instance, Russell (2004) noted that Hispanics tended to benefit more than other groups from the basic benefits of UR (understanding of the research process, confidence in research abilities, and awareness of academic and career options). Others have found that for students of color, the UR experience is related to increased frequency of graduate study (Hathaway et al. 2002). Additional studies have examined how to improve existing UR programs to encourage further student development (Gates et al. 1998). For example, a barrier to minority student participation in UR may be the lack of under-represented minorities at particular institutions. Some studies include analyses of how to overcome this barrier by broadening student participation using multi-institutional programs. Common strategies include partnering with historically black colleges and universities and other minority-serving institutions; undergraduates’ participation in minority-based student and professional associations; and institutional participation or recruiting at conferences for minority students (Boyd and Wesemann 2007).

Other tactics focus on improving participation of various groups within a single institution by identifying and directly addressing barriers to current students’ involvement. One example is increasing student awareness of UR. At Rutgers, a large public research-intensive university, students’ lack of awareness of UR opportunities was defined as an issue (Merkel 2003). Others have suggested that issues of time management of coursework and research, lack of knowledge about research and its benefits, and fears or feelings of inadequacy (Gates et al. 1998) prevent students from participating.

While this speculation is interesting, what is missing is hard data on why students from specific subpopulations on campus fail to access UR opportunities, especially in the professional programs such as architecture and business, where student participation rates are especially low. We suspected that some questions specific or especially germane to Latino undergraduates in professional programs would include: Are Latino students in professional programs unaware of UR opportunities or do they just see them as irrelevant? Do they feel inadequate about their ability to participate in research? Are there other reasons that cause them to eschew UR?

Similarly, general discussions of the impediments to faculty involvement in UR allude to faculty members’ feeling that most undergraduates are not qualified to conduct research in the professors’ disciplines; faculty time constraints or lack of a supportive institutional culture acknowledging such mentoring in promotion and tenure procedures (Johnson 2002; Hu et al. 2008; Harvey and Thompson 2009); or fears that time spent mentoring will decrease their own research productivity (Prince et al. 2007; Harvey and Thompson 2009).

We wondered if these barriers were also responsible for faculty non-participation in UR in professional programs such as business. Or do other factors come into play due to the nature of these programs, such as the educational goals of the Latino students or the professional goals of the business faculty?

Recent analyses of the Higher Education Research Institute’s Faculty Survey, National Survey of Student Engagement and Faculty Survey of Student Engagement correlate different faculty traits with probabilities that they will become UR mentors. Factors include institution type, discipline, and external funding (Eagan et al. 2011; Webber et al. 2013). Interestingly, certain personal traits also correlated with increased UR mentorship, such as an interest in student intellectual, academic, and professional development, as well as belief that students are well prepared academically.

Research Framework

Given the exploratory nature of our research questions and the gaps in the literature, we chose to convene student focus groups and interviewed faculty members one-on-one to explore our questions, using well established qualitative research techniques. The study used an exploratory naturalistic-inquiry approach. An exploratory data analysis has been described as a “method for discovering unforeseen or unexpected patterns in the data and consequently [for] gaining new insights and understanding of natural phenomena” (Gall et al. 1995, 197). We wanted to give students maximum opportunity to explain and discuss their perceptions of what research is and how it might enhance their college experience or career success. This was particularly important given the gap in the literature concerning why students chose not to participate in UR. We also wanted to provide the maximum latitude and confidentiality to faculty to allow them to openly discuss any hesitations or caveats about becoming a faculty advisor to an undergraduate researcher.

We used content analysis to analyze our data (Lincoln and Guba 1985), a method refined from the constant comparative method, which includes unitizing data, categorization, and identifying patterns. Patterns imply recurring regularities in the data, themes that occur frequently enough to
suggest a shared reality (on one or more issues) among the participants.

The over-arching research questions that framed our student focus groups were:

1. How do under-represented undergraduates majoring in business at a large state research-intensive university define research?

2. What are the reasons for the failure of under-represented undergraduate business majors to participate in academic research?

The over-arching research questions that framed our faculty interviews were:

1. What qualifications do faculty look for in undergraduates in order to consider working with them on a research project?

2. What are the difficulties faculty encounter with engaging undergraduates in a research project in their field?

We then developed them into a protocol for the focus groups. Two focus groups of seven students each were conducted.

At this research-intensive university, 21 percent of sophomores are Latino, while in the College of Business, 14 percent of the total undergraduate majors are Latino. (At other research-intensive universities in Texas, Latino students make up 19 percent, 21 percent, and 30 percent of their overall undergraduate populations, respectively. At one such institution 27 percent of their undergraduate business majors are Latino.)

Seventeen faculty from the College of Business (see Table 2) were interviewed for our study. At this college, 69 percent of the total faculty are white and 3 percent are Latino. Among tenured or tenure-track faculty, 64 percent of the faculty are white and 3 percent are Latino. (Similarly, at the College of Business in another Texas research university, 63 percent of the tenured/tenure-track faculty are white and 6 percent are Latino.) Individual faculty members were approached and recruited for one-on-one interviews. We attempted to interview only faculty who had not previously worked with undergraduate researchers on independent projects outside of the classroom. Our faculty subjects were chosen from different departments in the College of Business and ranged from assistant to full professors, so that we could obtain a broad view of the culture within the College of Business and the extent to which specific barriers existed in multiple departments.

Student data were analyzed using the content-analysis and constant-comparative methods (Guba and Lincoln 1989). Interviews were recorded and transcripts made; the material was organized into six general categories (research, reasons against research, expectations after college, undergraduate experience, classroom experience, and reasons for research),

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<tr>
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<td></td>
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</tr>
<tr>
<td>Female</td>
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<tr>
<td>19*</td>
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<td>43%</td>
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</tr>
<tr>
<td>Senior</td>
<td>3</td>
<td>22%</td>
<td></td>
</tr>
</tbody>
</table>

*Mean category

Primarily sophomore students (see Table 1) in the College of Business were recruited through a minority-student business group, since many research-active students in STEM (science, technology, engineering, and mathematics) majors first become involved in UR at this stage. We specifically chose only students who had not yet had experience in UR (with the rare exception of participation in psychology studies) to explore their attitudes and perceptions of UR. One Latino student initially was chosen for a one-on-one, in-depth interview to give us a general overview of ideas and issues.
plus a “miscellaneous” and a “demographics” category. The six major categories were broken down into subcategories for further analysis.

From the faculty interviews, data were sorted into three categories (definition of research, reasons for research, and reasons against research), plus a “miscellaneous” and a “demographics” category. These three faculty categories also were then broken down into subcategories.

Results and Discussion

Findings from student interviews. Based on previous studies (Stefani et al. 1997; Gates et al. 1998; Kinkead 2003) that elaborated on the difficulties undergraduates encounter in participating in UR programs, we fully expected our student focus groups to discuss similar issues, including time management, lack of knowledge of the benefits of UR or how to get started, or feelings of inadequacy regarding ability to meet the challenges of UR. While we did encounter all of those issues in our discussions, to our surprise the most prominent barrier to UR for Latino business students was much more basic: Many of the students did not understand what the term “research” meant in an academic context and could not envision how it might apply to them or their discipline.

Latino students had four major reactions to our asking them how they defined “research.” First, most students attempted to define the term “research” by giving an example. Several Latino students gave examples of research that were specifically laboratory-related, based on what they had heard from friends in the STEM fields. Many Latino business students had trouble coming up with an example of research in their own field. The belief that research is restricted to a laboratory setting may indicate why Latino business students are unable to envision themselves doing UR. Other Latino students cited experiences in which they had participated in a research project as a subject of a marketing or psychology study; they were unable to differentiate between being a research subject and a research investigator. Some Latino students cited research they have read popular articles. Unfortunately, further probing revealed that some students considered “research” to include comparing information that was already known, for example comparing requirements for degrees from various business schools. This lack of understanding of what the term “research” means in an academic context suggests that Latino business students define “research” according to the specific social context in which they have had a general experience labelled as “research.” They have difficulty generalizing the concept of research to their business studies, and thus in seeing how they might participate and what the value would be.

The second most common response was to consider research as the process of collecting data to learn something. Some Latino students started out thinking of research as “basically collecting data,” but then moved on to discuss using the data to answer specific questions. This led to the idea of having more knowledge about a subject, but it was not clear that the students could clearly differentiate between knowing pieces of information (data) versus having a better understanding of a technology or situation.

A significant number of Latino students were confused about what research might be. As one student put it, “…everything in life is research. Except some things have other names for it.” In later discussions, Latino students made a clear distinction between internships and research experiences. However, this distinction was completely due to where the experience took place (internships took place at companies, research experiences at universities). When it was pointed out that many companies engage in research (and even have units called “R&D” or “product development”) the line between internships and research began to blur and confusion set in.

Finally, some Latino students felt research was the underpinning to some greater purpose. One student said of research, “It’s a starting point for something bigger.” That vision and the desire to make a difference frequently drive students to become engaged with UR. However this group of Latino students also indicated that they felt inadequately trained or incapable of contributing productively to research projects, questioning whether projects with student contributions could be legitimate. We believe this focus on the outcome of research as necessitating a great contribution discourages some students. They may feel incapable of delivering such a product and therefore disinclined to think seriously about UR. However, with the right kind of mentoring, this kind of idealism could be tapped to induce Latino students to participate in a research project much as they volunteer for charity events, community projects, and fund raisers.

Other structural constraints in the business program may also discourage student interest in research, especially among Latinos. For instance, business degrees are designed for practice instead of research. In business, employers place a great deal of emphasis on internships and similar practical experience rather than on UR experience, leading business students to value “real world” experiences more highly than research. Undergraduate degrees in management or marketing offer a limited number of pre-established electives that do not include research, focusing instead on a variety of topics such as leadership, business law, or sales. Undergraduate degrees in management or marketing offer a wider variety of classes, such as laboratory and field courses, that introduce research techniques. Some STEM majors, in fact, explicitly require UR experiences in order to graduate. The College of Business we studied does not include a compulsory module on research methodology.

In many cases STEM faculty involved in research are more likely to interact with undergraduates and become a source of
research information than are faculty in the business school. For instance, researchers in STEM who instruct undergraduate students are more likely to present research relevant to class topics and get students involved than researchers in management theory are likely to do with business students. Faculty members in the business school acknowledge that they focus on post-graduate students and do more theoretical work.

A final aspect that may hinder business undergraduates from engaging in research is a narrow definition of research. Accounting, management, retail, or marketing students engage in analysis of markets, marketing, customer, or business plans that may not meet the definition of research used by faculty traditionally involved in UR or by researchers on the business faculty themselves.

Findings from faculty interviews. From our reviews of the literature, we expected business faculty members to avoid becoming UR mentors because of constraints on faculty time, an institutional or departmental culture that does not explicitly value UR mentoring, and the dearth of truly qualified undergraduates. While all of those points were brought up extensively in our faculty interviews, one of the most interesting set of responses—given the results of our student focus groups—was the business faculty members’ perception that business students are uninterested in research in general and UR in particular.

From the business faculty members’ point of view, most business students are not interested in UR, in part because “they want a job” or more specifically because “95 percent [are] headed towards careers or getting an MBA.” Motivation and commitment were also perceived as big barriers to student interest in UR. Faculty commented on how lack of interest on the part of a student would probably kill a research-oriented course, or they expected students would drop out when they found out how much work UR entails, especially when a UR project or course did not fit into their curriculum.

Business faculty who had attempted to require reading and analysis of academic papers in their courses found that students had strong negative reactions to the experience. These student responses to attempts to introduce academic theory, research, or scholarly articles into the classroom resulted in many faculty feeling as though students considered research an irrelevant activity. Furthermore, business faculty told us that their students have no interest in the “higher, noble goal that scholars have. That finding truth with a capital ‘T’.” And at least one faculty member told us that if a student were truly interested in research, he or she would have chosen to major in economics rather than business.

In fact, the category of faculty comments regarding unqualified students and the gap between the research students can do in a class setting and scholarly research that is publishable. This category also ranked ahead of faculty mentions of barriers previously documented in the literature, such as departmental culture and faculty time.

Conclusion

The majority of previous studies have focused on the difficulties encountered by students and faculty already engaged in UR programs or in individual projects. Many of the early studies used surveys to reach a large number of participants easily (Lopatto 2004), while a handful of later studies have engaged participants in in-depth interviews (Auchincloss et al. 2014). The well-documented stresses associated with UR for students includes access to research opportunities (Wood 2003; Desai et al. 2008; Harrison et al. 2011); the stress related to balancing research with coursework (Rowland et al. 2012), commonly referred to by students as “time management”; and identifying opportunities to develop ownership of projects (Auchincloss et al. 2014). Surveys of faculty mentors commonly identify conflicting time pressures and research productivity, as well as cultures that do not value UR participation, as reasons to avoid mentoring undergraduate researchers (Hu et al. 2008; Douglass and Zhao 2013).

Few studies focus on students and faculty who do not participate in UR to ask them why they abstain from this activity, although a significant fraction of students and faculty at many institutions fail to participate in UR (Douglass and Zhao 2013; Webber et al. 2013). We studied matched populations of Latino business students and business faculty (from the same college at the same research-intensive institution) to see if any other issues or barriers not previously identified in the research literature deter them from engaging in undergraduate research. While both students and faculty mentioned issues identified in earlier studies, we found that a large number of Latino students were very hazy about the definition of research in an academic context and may have difficulty figuring out the benefits they would receive from engaging in research. We surmise that this led Latino students to be uninterested in UR in the face of competing opportunities for internships, study abroad, and similar, more obviously beneficial activities. This meshes well with the observation by many of the business faculty members that their students are not interested in research (and therefore that it is not worth their time to try to engage their students in research outside the classroom). Unfortunately, these two misunderstandings reinforce each other, creating a climate in which Latino students do not seek UR experiences outside the classroom and faculty members see no reason to offer them.

The situation also reveals that a common strategy for increasing UR participation—greater publicity and advertising
of opportunities—may not yield significant results unless personnel carefully explain the nature and value of UR for business majors, especially since Latino business students are liable to dismiss the information as not relevant to them and their career goals. Even during the short time of a student focus group (one to two hours), however, students became enthusiastic about doing research once they understood what it would take, what they would gain from it, and learned that research takes place in a variety of industries in a variety of ways. This suggests that a discussion of what academic or scholarly research is and what its benefits are—including a greater understanding of coursework and hands-on-experience—could generate greater interest in UR among Latino business students.

Business faculty could certainly provide this discussion of what UR is in the world of business and what its value is for students. We suspect that if the topic were embedded in a panel discussion by business professionals, their credibility might create even more interest in UR, just as the perception that UR will improve students’ chances for admission to medical school causes many pre-med students to seek UR experiences (Harrison et al. 2011; Chang 2013; Franco 2014).

Limitations of the Study

This study was carried out on business faculty members and Latino business students at a large public research-intensive institution. It is possible our results are not generalizable to other under-represented students if the barriers that Latino students face in understanding the nature of research and its value are not the same as those encountered by other minority students. Since the students we targeted were primarily sophomores, it is also possible that they will be more aware of the opportunities and benefits of undergraduate research as seniors, when they will have had more integrative learning experiences. Furthermore, the focus on a business college may mean that the problems encountered there are not the same as those that would be found in other “professional” programs such as education or architecture, which also have a tradition of low faculty and student engagement in UR.

We are currently engaged in similar studies analyzing the responses of students and faculty in the College of Education at a large public research-intensive university. The large size of the institution and the resulting high student-to-faculty ratio suggest that the results may not translate to institutions where there is more individualized attention given to students by faculty. As a future research agenda, we are considering similar studies at additional types of institutions, academic departments, or colleges, and with different populations of students, in order to determine how generalizable these results may be.

References


Undergraduate Research in Humane Education: Benefits Gained in Action Research

Student research has become an important building block in undergraduate education. Undergraduate research experiences are carried out in many formats—some are embedded in courses while others stem from individual contracts between students and faculty members (Cooley, Garcia and Hughes 2008). In these activities, undergraders’ roles vary from course participants to paid research positions to volunteers (Dolan and Johnson 2009). The growing interest in undergraduate research has generated studies designed to examine the benefits undergraduates gain from their experience, including knowledge-related gains such as intellectual curiosity and content knowledge; skill-related gains such as analytical and logical thinking, synthesis of interdisciplinary knowledge, and skills in research processes; and professional advancements, such as influence on career plans and motivation (Hartmann, Widner, and Carrick 2013; Ishiyama 2002; Lopatto 2010, Madden, Ammertorp, DeNarie and Farrell 2013; Orr 2011). However, studies outlining the benefits of undergraduate research typically examine research in science; relatively few studies focus on research in humanities and education, and I have found no studies reporting on benefits of undergraduate student research into humane education.

Humane education has traditionally focused on the awareness of animal welfare and safe and respectful interaction with animals (Thomas and Beirne 2002). Recently, the definition of humane education has transformed into an inclusive concept that also encompasses environmental, consumer, and human-rights issues (Tate 2011; Thomas and Beirne 2002). In accordance with this comprehensive definition, educators teach environmental-education themes along with a “kindness” curriculum that stresses responsibility and respect for people, animals and the environment (Faver 2010). Although the need for integration of such humane education into curricula is well-established, research is needed to prepare undergraduates who can deliver humane education while also engaging action research.

In action research, educators conduct course-based research to find ways to improve instruction, subsequently increasing student achievement (Kincheloe 2003; Zeichner and Noffke 2001). Action research has many benefits, such as contributing to the knowledge base, offering venues for professional development, strengthening collegial efforts, and finding solutions for a problem of practice (Shilkus 2001). All these benefits might validate the importance of including undergraduates in action research, so I conducted a course-embedded action research experience in humane education at Florida Gulf Coast University that produced some recommendations for implementing such research experiences in other college classrooms.

Context: Course-Embedded Action Research

The undergraduate research was embedded in the honors course Research and Service in Humane Education, which was a combination of service in humane education and action research. Students from various disciplines registered for the course. In the course, the students increased their competencies in: (1) designing an action-research plan in humane education, (2) teaching lessons in humane education, and (3) collecting and interpreting data and disseminating research findings. The course consisted of on-campus classes and the implementation of seven humane-education lessons on dog safety in kindergarten classrooms. During the first six weeks of on-campus coursework, students gained knowledge about research processes and humane education, and they also designed their own action research. For humane-education lessons, participants modified the lesson plans in the KIDS: Kids Interacting with Dogs Safely package (Deming, Jones, Caldwell, and Phillips 2009).

Built on a literature review of programs on dog safety, the students identified two research questions derived from the lessons they would teach kindergartners: (1) To what extent have the lessons increased kindergartners’ knowledge about safe interactions with dogs? (2) Have the kindergartners demonstrated more acts of kindness, respect, and responsibility by the end of the human-education program? Students then developed pre-research and post-research tests to measure the change in the youngsters’ knowledge and skills regarding dog safety, and students devised an observation chart for documenting the character values. All students pursued the same the research questions and measurements, but each conducted individual action research in a separate kindergarten classroom.

The undergraduates taught seven 30-minute lessons in kindergarten classrooms in three different schools. They targeted objectives such as addressing dogs’ needs, demonstrating proper behavior around dogs, and increasing empathy, respect, responsibility, and kindness through acts such as reading aloud with follow-up activities, role-playing, coloring, drawing, singing, and participating in the dog-safety program’s graduation ceremony (see more details in Szecsi, Barbero, DeCampo, and Toledo 2010). Throughout the semester, students in research teams of two or three assisted each other with lesson planning, implementation, and data collection.
Student Benefits from Action Research

Answers to the question, “What benefits did undergraduate students gain in a course-based action research experience in humane education?” yielded the following themes: (1) increased skills in action research, (2) appreciation of the need for interdisciplinary collaboration, (3) increased self-efficacy as action researchers, (4) career considerations, and (5) professional advancement.
mirrored in the post-research self-efficacy survey. In particular, as revealed in Table 1, there was a gain of 38 percent in their confidence in their abilities regarding “clearly explaining new concepts” (to a mean of 4.3); a 36-percent gain in “motivating and maintaining children’s interest” (to a mean of 4.4); a 36-percent gain in “handling behavior problems” (to a mean of 4). Only their perception related to “reaching out to English language learners” (at a mean of 3.3) remained a challenge, producing the lowest gain, 22 percent. Overall, students perceived improvement in their confidence about teaching, which also was evident in the kindergarten classrooms.

Table 1. Self-Efficacy Survey’s Pre-research/Post-research Scores and Gains

<table>
<thead>
<tr>
<th>Categories</th>
<th>Mean of Pretest Score</th>
<th>Mean of Posttest Score</th>
<th>Total Gain (Gain as a Percentage of the Likert Scale)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clearly explaining concepts: Explain information related to KIDS program to children</td>
<td>2.4</td>
<td>4.3</td>
<td>+1.9 (38%)</td>
</tr>
<tr>
<td>Motivating and maintaining interest: Raise and maintain children’s interest toward topics in KIDS program</td>
<td>2.6</td>
<td>4.4</td>
<td>+1.8 (36%)</td>
</tr>
<tr>
<td>Handling behavior problems: Maintain discipline in kindergarten</td>
<td>2.2</td>
<td>4</td>
<td>+1.8 (36%)</td>
</tr>
<tr>
<td>Reaching out to English language learners: Explain new information in KIDS program to children who barely speak English</td>
<td>2.2</td>
<td>3.3</td>
<td>+1.1 (22%)</td>
</tr>
</tbody>
</table>

The numerous drafts and the final version of the students’ research reports showed growth in the proficiency students needed to develop a literature review and to analyze and interpret data. Also, their weekly data-collection reports during the humane-education lessons indicated growing depth and breadth in their data-collection and organizational skills. Specifically, most students reflected on skills essential for conducting research, for example on organization. One student said, “Through this class I developed organization and time management.” However, not all students mastered this skill, as one stated, “The only negative outcome of this experience would have to be that I put so much time and effort into this that my grades kind of suffered in other classes, but it was well-worth the life experience.” As action researchers, the students became aware of the extensive time, effort, and organization needed to complete quality research, and they gradually demonstrated growth in these areas.

Appreciation of the need for interdisciplinary collaboration. Interdisciplinary collaboration was a cornerstone in this action research because the nature of the project required knowledge and skills from various disciplines, for example, pedagogy, environmental science, animal care and animal rights, and educational research. All students’ reflections indicated they enjoyed and appreciated this interdisciplinary collaboration. For example, they perceived the kindergarten teacher as a coach guiding them in classroom management, handling behavioral issues, and modeling effective approaches to learning. Furthermore, they appreciated the added value of the peer-collaboration. Research team members from various disciplines brought diverse strengths and contributed accordingly to planning lessons, observing peers, and collecting and analyzing the research. Each step in the action research required well-orchestrated collaboration among peers and teachers. As a result, students’ skills in interdisciplinary collaboration seemed to be strengthened.

Increased self-efficacy as action researchers. As the course unfolded, students consistently reflected on their self-efficacy as action researchers. At the beginning of the semester, the students, predominantly freshmen and sophomores, felt nervous and unsure about their competence to effectively conduct research and deliver lessons. As the weeks progressed, their preparation in both research and teaching gradually generated positive feelings, such as “thrilled, rewarded, and pleased,” as they documented in their weekly and final reflections. Ultimately, the “distressed and uncomfortable” feelings transformed into “progressively growing confidence and excitement.” This was accompanied by a sense of accomplishment and pride in completing the research. For instance, a student majoring in special education proudly stressed the difference this action research made in children’s lives, saying, “Having finished this project, I am very pleased with myself. In my opinion, this project really had a positive impact on the children and it feels good to be a part of that.”

Another freshman majoring in biology summarized her sense of accomplishment by saying, “I am happy that I chose this course. I was forced to step outside of my comfort zone, which ended up being really beneficial. After completing the project, I felt extremely proud of my progress. I feel our research was meaningful and we actually accomplished something.” Without exception, students recognized the value of the new knowledge and skills gained in this action research, and they confidently communicated this positive transformation.

Career considerations. This research made all students carefully consider their majors, future careers, and interests in research. For example, five students majoring in music, communication, and other areas started to consider teaching as a profession. One music major stated: “Over the course of this program, I actually added music education to my music performance major. I think I could really enjoy teaching music to kids, which was something I did not know before.”
On the other hand, a student majoring in elementary education reconsidered her future path, saying, “This class with the help of many teachers led me to change my major. Now before you think this experience was horrible, I will tell you it was quite opposite. Through this experience I learned that teaching was not my niche.”

Furthermore, in her reflection on the decision-making process about her career, a student majoring in environmental sciences pointed out the university’s responsibilities to offer real-life experiences. She noted, “I think there should be more classes like this, where you have the opportunity to actually experience different careers. How are you ever supposed to know what careers you would truly enjoy if you never leave the classroom?”

In addition to career considerations, almost all students seemed to experience some increased interest in future undergraduate research. For instance, one student said, “It would be amazing to have time to combine our results to come up with a huge research project.” A year later, she and two other students signed up for an independent study to conduct the meta-analysis of the students’ findings in the action research with kindergartners. This sustained interest in research clearly indicated confidence in their research competencies and dedication to advancement in research. Four students decided to extend this research to fit into their senior thesis in the honors program. Almost all reflected on the transferability of these research skills to other disciplines. As one noted, “The knowledge I have gained in research methods and writing a research paper is also very beneficial, since my goal is to do research (although in science and not education).” The magnitude of the students’ professional transformation as researchers was expressed when they described the research experience as “a life changing experience,” and referred to its long-term effects. As one said, “I gained skills that I can carry on in life. This course helped me learn more about myself by allowing me to see where I excel and where I need to focus more time.”

Professional advancement. The action research contributed to the students’ professional advancement by enriching their resumes. All students presented their findings at the university’s Service Learning Summit and Research Day. In addition, five of them took their research to national conferences, including the Association of Humane Educators and the National Collegiate Honors Council. Three students received conference awards for the quality of their research. As one student stated, “In this class, I developed a study which has taken me to many places [conferences], and has expanded my horizons.” In addition, a co-authored article (Szecsi et al. 2011) not only served as testimony to the students’ skills as researchers, but also strengthened their applications for graduate school. Overall, the students perceived their scholarly involvements at national academic forums as important first steps to seeing themselves as researchers and contributors to the knowledge base.

Conclusions and Recommendations

This course-embedded undergraduate research experience took place in an interdisciplinary context with students from various disciplines conducting action research in humane education. Given the small number of students involved, the primary benefit for me was the in-depth examination of their attitudes and perceptions of benefits, rather than more generalizable findings. Although more participants might add additional perspectives, it would not challenge the existence of the benefits provided to these participants (Ernest 2001), who were honors students who registered for the course based on their inherent interest. It is important to consider that honors students are academically more prepared and dedicated to their studies than the general college-student population. Therefore, the benefits accruing in this preliminary qualitative study cannot be generalized beyond the context of this course. For more generalizable findings, it would be meaningful to examine the benefits of undergraduate research in humane education in larger courses enrolling the general population of college students.

This preliminary study explored important gains in terms of students’ growth and personal and professional enrichment. The findings of this study substantiated findings of previous studies on benefits of research in STEM fields and the humanities, such as an increase in research skills—specifically in thinking analytically and logically (Ishiyama 2002), understanding the nature of science (Miller, Hamel, Holmes, Helmey-Hartman and Lopatto 2013), and technical and research abilities (Lei and Chung 2009). However, this study offered a new perspective on the benefits of undergraduate students’ involvement in action research. It allowed undergraduates to gain first-hand experience with the profession of teaching and to experience the role of teacher-researcher. It is vital for undergraduates to gain experiences with diverse professions before making decisions about their future careers. Undergraduate action research is a promising avenue to offer these experiences.

This study suggests that undergraduates started seeing themselves as active decision makers in scientific processes rather than as consumers of research results. Furthermore, these action researchers were actively involved in testing instructional practices and produced findings for data-driven decisions in education. This early participation in research endeavors increased their self-confidence as effective researchers (Adedokum, Zhang, Parker, Bessenbacher, Childress and Burgess 2012; Cross, Moran, Wodarski, Harrison and Dunbar 2013). Such enhanced self-perceptions are important for undergraduates pursuing goals in research and future educational or career advancement (Hartmann et al. 2013).

The interdisciplinary undergraduate research in this study was built on collaboration between academia and the community. During this service-learning activity—teaching humane education programs to children—undergraduates...
experienced the benefit of such collaboration. Their findings documented children’s learning and growth, and at the same time the undergraduates experienced professional improvements as teachers and researchers. Therefore, incorporating community involvement into undergraduate research is a meaningful way to prepare students to improve their communities through interdisciplinary research collaboration.

References


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Tunde Szecsi is a professor of education at Florida Gulf Coast University in Fort Myers, Florida, where she is co-leader of the elementary education program. Since 2003 she has taught courses on humane education, early childhood education, and English as a second language. She served as coeditor of the 2007 and 2012 international theme issues of the journal Childhood Education, and also served as the coeditor of its “Teaching Strategies” column. Over the past decade she has made numerous presentations throughout the world and contributed to more than thirty articles and six book chapters on child development, multicultural education, culturally responsive teacher preparation, and humane education. She earned her master’s degrees in Hungarian, Russian, and English language and literature in Hungary and obtained her PhD in early childhood education at the University of Buffalo.
Integrating Evidence-based Practice into Nursing Education: Partnering for Success

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For nurses to deliver high-quality and safe care, clinical decision-making must be informed by the best evidence, and this starts with research. All nurses need to be informed regarding the tenets of evidence-based practice (EBP), yet few are educationally prepared. The nursing faculty at Florida Atlantic University recognized a need to enhance the curriculum to include experience translating research and evidence into practice.

A three-course inquiry series was created that included the existing nursing-research course, plus a two-credit evidence-based practice course and a one-credit capstone course. The two-credit course covers the history and the role of evidence-based practice in health care, and models of EBP and quality improvement. During the capstone course students are divided into groups and partnered with a local health-care facility or community agency in order to conduct an evidence-based practice or quality-improvement project tied to the needs of the partners. Potential benefits to the partners include resources such as students’ time and access to the university’s databases, something often lacking at the point of care. The students in turn are exposed to real-world issues and become part of a multidisciplinary team.

To evaluate the students’ perspectives about the capstone project, a focus group was conducted with the first cohort of students in the course. Challenges identified were the time commitment involved and scheduling and coordination with the facilities. Although the students found the partners helpful, insufficient communication within the facilities hampered some activities. The students said they initially did not see the need to learn about evidence-based practice because they were more concerned with learning patient-care skills, but that later they came to appreciate EBP. All the capstone projects contributed in some manner to delivery of care, and some facilities chose to continue the projects with the participation of students in the subsequent student cohort.

American Speech-Language-Hearing Association Encourages Undergraduate Researchers at Convention

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Professional associations can offer unique, national-level opportunities to augment and showcase campuses’ undergraduate research efforts. The American Speech-Language-Hearing Association (ASHA) is the national professional, scientific, and credentialing association for more than 173,000 members and affiliates who are audiologists; speech-language pathologists; speech, language, and hearing scientists; audiology and speech-language pathology support personnel; and students. ASHA offers a number of programs that support undergraduate research, one of which is the PROmoting the Next GENeration of Researchers (PROGENY) program. Since 2008, more than 200 undergraduates who are first authors of posters accepted for presentation at ASHA’s annual convention have participated in the program. It incorporates three important elements to encourage undergraduate research: engagement, research-career development, and recognition.

ASHA pairs each participant with an active researcher in a related content area who is not affiliated with the student’s home institution. This volunteer researcher visits the poster session and engages the student in a discussion about the research presented and about future opportunities.

ASHA invites the PROGENY participants to attend specific convention sessions designed for undergraduates with a burgeoning interest in research. One session includes a panel of successful researchers who highlight the different paths, research questions, and settings available for a research career in our discipline. Another event is an informal roundtable that allows the students to network with researchers and discuss topics of particular interest to undergraduates—for example, “Thinking About and Selecting a PhD Program.” ASHA also recognizes the PROGENY participants’ research accomplishments by posting their names on the ASHA website, congratulating them in an electronic newsletter disseminated to the academic community, and honoring them at the convention’s Researcher-Academic Town Meeting event.

The program can have direct results. For example, the connections Katelyn Lippitt made during her PROGENY participation while she was an undergraduate at the University of Maryland-College Park led her to Purdue University, the institution at which she will pursue her PhD. She said of PROGENY’s impact on her decision: “When I met my PROGENY match during my poster presentation, she invited me to Purdue University and arranged a visit for me. That visit really got me thinking about various areas of interest and mentors for my graduate study. Progeny took the direction I already had and gave me more concrete means of pursuing it.”

In addition to PROGENY, ASHA supports undergraduate research through two award programs and by collecting data on academic programs’ use of selected best practices, included in CUR’s Characteristics of Excellence in Undergraduate Research.
Kinesiology Field Work Enhanced with Undergraduate Research

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A unique children’s summer camp at the university’s outdoor recreation facilities, created and implemented by kinesiology students at Midwestern State University, was established in the summer of 2010. The students were given opportunities to work on developing, implementing, and managing an on-site learning experience with the campers. The program gave the university students a real-world environment in which to sharpen their skills in communication and apply best practices for teaching fitness and outdoor activities to children. The project continued in later years and during the 2014 camp, faculty added an undergraduate research component to the coursework. During a summer kinesiology course, in the three weeks leading up to camp, activities and assignments were used to facilitate students’ research skills. Students first explored qualitative research by reading assigned journal articles and identifying examples of qualitative research on their own. Specific in-class discussions concentrated on understanding the purpose and methodologies of qualitative research. Students also did mock interview sessions using guided-interview questionnaires designed for the elementary campers. The guided interviews allowed the students to pursue in-depth information on each camper’s unique experience, including questions about perceived skill knowledge and learning of the activities offered at camp and the camp experience.

On the first day of camp, for which the university students designed and implemented a variety of outdoor and fitness activities, each kinesiology student was assigned to mentor one or two children so that all elementary students had a college student to connect with during camp. The student mentors were allotted time to sit with their mentees to explain the research component, to obtain the elementary campers’ unique experience, including questions about perceived skill knowledge and learning of the activities offered at camp and the camp experience. On the final day of camp, another round of interviews was completed, and journals written by the campers were submitted. In the fall following the summer camp, students interested in continuing participation were invited to participate in the analysis and presentation of the collected data. The benefit of the experience was introducing future professionals to the concept of research and the role of research in the field of physical education.

Initiating & Sustaining Undergraduate Research Programs

Next Offering: Oct 15-17, 2015  
Location: University of Missouri  
Application Deadline: Sep 12, 2015

This institute has the following goals:

• To provide models of effective academic-year and summer UR Programs.
• To share models of the integration of UR into the curriculum.
• To equip UR Program directors and committees with a “tool-kit” of essential items needed for running an undergraduate research center or program, including models of responsible conduct of research education.
• To provide attendees with information they can use regarding resources needed (staffing and other resources) to establish a new program.
• To provide access to resources that are available for continuous growth and development of a campus undergraduate research program including faculty development and undergraduate and graduate student training to be effective mentees and mentors.
• To provide UR Program Directors with “mentors” who are willing to provide advice after the institute ends. Mentors will be from a wide range of institutional types.
• To begin a network that will extend beyond the dates of the workshops.
• To share a variety of campus models and program components that include broad disciplinary scope and focus, and work with students at different stages of their academic careers.
General Criteria —
The CUR Quarterly publishes articles relating to all aspects of undergraduate research that are of interest to a broad readership. Articles regarding the effects of the research experience on the development and subsequent endeavors of students, and how to initiate, support, or sustain undergraduate research programs are appropriate for this journal. The CUR Quarterly is not the appropriate venue for publishing results of undergraduate research.
Manuscripts that are unrelated to undergraduate research or focus on the success of an individual or institutional undergraduate research program without providing a substantive presentation of goals, strategies, and assessed outcomes related to the program are not suitable for publication. Manuscripts that describe novel programs that can serve as models for other institutions, those containing significant assessment of outcomes, and those articulating research on the efficacy of undergraduate research programs are particularly suitable for publication in the CUR Quarterly.

Editorial Policies —
The CUR Quarterly is the voice of members of the Council on Undergraduate Research. All articles are peer-reviewed. Editorial judgment regarding publication of manuscripts and letters rests with the Editors. Concerns about editorial policies and decisions should be addressed to the Editors.

Manuscripts

Prepare to Submit —
• Copy of article (MS Word or compatible format, Times font, 12-point, double-spaced, 1 inch margins, and single-spacing between sentences). 2000-3500 words is the typical length of an article, but longer or shorter articles may be appropriate for certain topics.
• Key words for indexing (up to 10).
• Personal information
  — Institutional title, mailing and email addresses for the corresponding author.
  — Biographical sketch for each author (4-6 sentences).
• Proper Citations. Refer to the Chicago Manual of Style citation guidelines-author-date style (http://www.chicagomanualofstyle.org/tools_citationguide.html).

How to Submit —
Authors are encouraged to discuss disciplinary articles with the appropriate Division Editor prior to submission. Contact information for all Editors is listed at the front of every issue of the CUR Quarterly. Once you are ready to submit you will need to visit http://curq.msubmit.net and complete the online submission process.

Book Reviews
The CUR Quarterly publishes short reviews of books and other new publications the editors deem of interest to the undergraduate research community. Books or other publications will be reviewed within 12 months of publication. The Book Review Editor will select appropriate titles for review and solicit reviewers. In order to ensure that the reviews are as timely as possible, the Book Review Editor will expect to receive finished reviews within two months of assignment. Each printed issue of the CUR Quarterly will include one review.

Suggested titles for review and book reviews should be submitted via email to:
Book Review Editor
Susan Berry Brill de Ramirez
brill@fsmail.bradley.edu

CUR Comments
The CUR Quarterly will consider for publication scholarly commentaries from readers on issues vital to the health and vigor of the undergraduate research enterprise. CUR Comments should be limited to 250 words, and must be on topics relevant to CUR’s mission. CUR Comments will be published at the sole discretion of the Editors and will be edited if necessary. The writer will be shown the edited version for her/his approval.

Undergraduate Research Highlights
Highlights consist of brief descriptions of recent (past six months) peer-reviewed research or scholarly publications in scholarly journals. These publications must be in print and must include one or more undergraduate co-authors. A quarterly call for submissions will be sent to all members and posted on the CUR Web site.
Submissions should include:
• Title of the article and full journal citation (inclusive pages).
• A brief description (3-5 lines) of the research and its significance.
• Title and department or program affiliation of the faculty member.
• A brief description of the student co-author(s). Include the year of study in which the student(s) undertook the work, the opportunity through which the work was undertaken, (independent study project, summer project, REU program, senior thesis project, etc.), and the current status of the student (graduate school, employed, still enrolled, etc).
• The source of funding for the work.
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