UNDERGRADUATE RESEARCH GOES ABROAD

Also in this issue:
Student-framed Inquiry in a Multidisciplinary Bachelor Course at a Dutch University of Applied Sciences

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To order a subscription, visit: www.cur.org/publications.html.

ISSN 1072-5830

The CUR National Office is published 4 times a year in the Fall, Winter, Spring, and Summer by the Council on Undergraduate Research at the address below:

734 15th Street NW, Suite 550
Washington, DC, 20005-1013

CUR Is on the Move!

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About the cover: Lower division students from the University of Washington in a guided arthropod diversity exercise in Mastatal, Costa Rica.
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From CUR’s President

Undergraduate research abroad. What is not to love about this idea? Two high-impact practices wrapped up in one great experience! The authors of the articles in this volume of CUR Quarterly provide compelling evidence for the value of undergraduate research abroad. As students engage in these two high-impact practices, they achieve many of the intellectual and personal gains with which we are familiar in undergraduate research community, such as ability to develop hypotheses, competency in use of tools within the discipline, proficiency in data analyses, understanding of the research process, and enhanced communication skills. On top of these outcomes, students develop intercultural competence and gain cultural awareness. Students return to their home country with a much deeper understanding of the global nature of knowledge generation and an enhanced ability to work across difference. An increased self-awareness and a higher level of comfort in taking risks also correspond with a research abroad experience. For institutions eager to combine these two high-impact practices, the articles in this volume of CUR Quarterly not only detail these outcomes but also describe successful models.

Undergraduate research abroad is one component of the growing movement in higher education to develop, enhance, and promote undergraduate research in countries across the globe. The World Congress on Undergraduate Research is another way in which undergraduate research students recently connected their work to the global community. The World Congress was hosted at Qatar University on November 12–15, 2016, and supported by CUR, the British Conference on Undergraduate Research (BCUR), and the Australasian Council for Undergraduate Research (ACUR). Collaborating across nations to present a multidisciplinary world congress, CUR contributed to a transformative undergraduate research event at which faculty and students came together from around the globe to listen and learn from one another; to share knowledge; and to discuss challenges such as climate change, sustainability, global health, information technology, and war and peace in the 21st century. Students participating in this powerful event will undoubtedly have returned to their home campuses energized and ever more ready to take on the challenges facing our world.

Although I was unable to attend this watershed event, my own thinking about undergraduate research has been significantly affected by international connections made through CUR, especially from the CUR preconference workshop at the annual meeting of the International Society for the Scholarship of Teaching and Learning. Learning about the approaches to assessment of undergraduate research in Australia, the integration of research into the curriculum in Great Britain, and the significant relationship between library faculty and undergraduate research at Canadian institutions has made me think differently about my own approaches to mentoring students and to developing undergraduate research programs. Because I have learned a great deal from these international connections, I was especially pleased that CUR hosted an institute, Initiating and Sustaining Undergraduate Research Programs, abroad this fall. Carleton University in Ottawa, Canada, hosted this institute with a number of participating U.S. and Canadian institutions, allowing for meaningful cross-country exchanges.

As undergraduate research continues to be of growing importance to higher education in nations all across the world, CUR is excited to continue dialogue with faculty from different countries and with international groups to explore ways that will enhance students’ abilities to generate new knowledge and engage in global problem-solving. Our students will benefit from doing and presenting research abroad, as they see how scholarship in their discipline is conducted in different cultures and contexts, and as they experience transformative cultural exchanges. Similarly, as faculty members and administrators learn how undergraduate research is practiced elsewhere across the globe, we will gain valuable insights into how to improve our own programs so that each of us involved in undergraduate research can offer the very best educational experiences possible within our own contexts.

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doi: 10.18833/curq/37/3/5

Undergraduate Research Week

Tell us about your initiatives to celebrate Undergraduate Research Week (April 3–7, 2017); they will be featured on the CUR website.

Email CUR@cur.org.
Most undergraduate students today do not remember a world without the Internet, cellphones, or GPS. Theirs is a world of connectedness and interconnectedness. A video chat with friends around the world is not only possible but also commonplace. There is an immediacy in the exchange of complex information. So, too, is there an increased awareness that the world is broader than the context of our local neighborhoods. The appliances of communication suggest a facile globalization in which otherwise geographically bound issues and perspectives are freed from the fetter of provincial chains. The reality is far more complex. That is where this issue begins its journey. To be connected is one thing, but as Jonathan Swift shows in the satirical eighteenth-century classic Gulliver’s Travels, mere connection is insufficient. Arrival is but the first step along a much less certain path. For today’s undergraduate, the “travel” is easy, but a deep understanding of the new world is far more elusive. This, then, is our task: How do we provide students with research opportunities that both assist in their comprehension and forge a better global community?

In the spring 2017 CUR Quarterly print issue, innovative models of undergraduate research in the international context are presented in two articles. “Establishing Undergraduate Project Centers in Cuenca, Ecuador, and Panama City, Panama” by Laureen Elgert and Aaron Sakulich (Worcester Polytechnic Institute) describes a project-based curriculum implemented at Worcester Polytechnic Institute in 1970. As part of the degree requirements, students must complete two research projects at one of 40 off-campus sites. Currently more than 800 students per year conduct research projects in these immersive settings, which not only increases students’ professional skills but also contributes to the development of a global competence. Elgert and Sakulich discuss the logistics of establishing two new project centers in Panama and Ecuador, as well as the importance of engaging local governments, NGOs, and other relevant stakeholders in research projects. They note that projects with tangible effects on the local community ultimately lead to better learning outcomes, as students are more likely to take ownership of these projects.

In their article, “Undergraduate Learning from the Ground Up: Linking Belowground and Aboveground Diversity in Costa Rica,” Daniela Shebitz (Kean University), William Eaton (Pace University), and Juyoung Ha (Kean University) discuss an undergraduate research program funded by the National Science Foundation that benefited students and a rural Costa Rican community. As part of the project, students traveled to a lowland wet forest located in a remote region in northern Costa Rica. Once there, they conducted a variety of studies examining the flora, fauna, and soil characteristics of the rainforest. While improving research skills, the program increased the students’ awareness about local culture, improved their confidence as researchers, and encouraged some students to apply for graduate programs in ecology. Furthermore, the research findings will be used to assist the community with local land management decisions.

John E. Banks and Juan José Gutiérrez (California State University, Monterey Bay) discuss the benefits of stacking high-impact practices in a global setting in their article, “Undergraduate Research in International Settings: Synergies in Stacked High-Impact Practices.” They present two case studies from the natural sciences and the social sciences involving three high-impact practices: undergraduate research, service learning, and study abroad. Banks and Gutiérrez discuss the benefits and challenges of implementing these programs, as well as the importance of creating a culture of research at the university level.

John McKillip (Ball State University) provides an interdisciplinary model for undergraduate research and the global community in his article, “Partnering with Students in Iceland and Continental Europe to Develop a New Undergraduate Microbiology Research Journal.” This unique program brings students from multiple disciplines together to manage Fine Focus, a peer-reviewed digital and print journal for undergraduate microbiology research. Because the journal is edited, designed, and marketed by undergraduate students, they are in a unique position to learn about the entire research process from start to finish.

In “Undergraduate Research Abroad: Different Program Designs Serve Different Needs,” Carol Bender (University of Arizona), Kirsten Yaffe (University of Arizona), and David Lopatto (Grinnell College) analyze the scientific and cultural gains of student participants in a group research experience in the Czech Republic and a solo research experience in various other countries, comparing these to outcomes for students involved in a domestic research experience.

The vignettes in the spring 2017 CUR Quarterly explore additional ways of implementing undergraduate research in a global setting. Aaron P. Boesenecker (American University) describes the School of International Service’s new curriculum, which provides several pathways for students to engage in undergraduate research in international settings. Kristine A. Hildebrandt (Southern Illinois University Edwardsville) discusses efforts to document the endangered languages of Nepal. She highlights undergraduate students’ work transcribing digital narratives, analyzing interviews, developing a word corpus, and constructing a community dictionary. Lastly, Maxwell Borella and Darren M. Gravley (Frontiers Abroad/University of Canterbury) present the Frontiers Abroad program, an international study abroad program for...
undergraduate students in earth and environmental sciences. Frontiers Abroad is administered by an educational organization with university partnerships in the United States and New Zealand. The program is unique in that it focuses on longitudinal learning by linking an intensive, five-week field camp that introduces students to research techniques and fieldwork skills, followed by a one-semester research course.

Although the benefits of research abroad programs are myriad, the monetary costs associated with overseas travel can serve as a significant barrier to student participation. Thus, short-term opportunities and the use of technology to promote international collaboration can offer substantial benefits to students who might otherwise miss these opportunities. CURQ on the Web features one article and one vignette addressing these issues. In their article, “A Delicious Connection: Global Awareness through Structured Multimedia Dialogue,” Brandon Inabinet, Amanda Richey, and Tami Blumenfield (Furman University) describe a novel program designed to foster dialogue between students in South Carolina and farmers in China. The project paired students in South Carolina with local farmers and food producers to create a documentary about food production in the United States. Students also created a second documentary about farming in China, using previously obtained footage from Yunnan province. As Inabinet and colleagues explain, students, by exploring farmer reactions to the documentaries during and after the film screenings, promoted a global dialogue about food production and increased their own awareness about international food production and sustainability issues.

In her vignette, “Enhancing Global Citizenship through Student Research Presentations,” Rachel Core (Stetson University) demonstrates that short-duration study abroad programs can encourage undergraduate research. She describes an optional spring-break seminar in Shanghai for students enrolled in her sociology class. While in China, students assumed the role of participant observers, taking field notes as they visited factories and farms, as well as met with representatives from NGOs. Upon returning to Stetson University, students analyzed their field notes and presented their research to fellow students.

The themes presented in both the print and online editions of CUR Quarterly challenge the academic community to engage students on several levels. As noted, technology appears to make the world smaller, while research innovations such as those presented in this issue reveal vast differences in culture, a diversity of ideas, and a range of sensibilities that blanket the Earth. In both subtle and more obvious ways, the contributors have shown how to bridge global gaps without falling victim to the temptations of exoticism or exceptionalism. Through these varied approaches, students come to appreciate other cultures without the dispassion of Swift’s Gulliver. Rather, students are given the tools to understand other societies on their own terms. In so doing, they create opportunities for mutual aid and deeper appreciation of the broader human condition.

Laurie Gould  
Georgia Southern University  
CURQ Issue Editor  

doi: 10.18833/curq/37/3/6
Establishing Undergraduate Project Centers in Cuenca, Ecuador, and Panama City, Panama

Abstract
In 1970, Worcester Polytechnic Institute adopted the WPI Plan, a unique undergraduate curriculum focusing on project-based learning. To graduate, all students must complete the Interactive Qualifying Project (IQP) and the Major Qualifying Project (MQP), as well as a humanities and arts sufficiency. The IQP is broadly defined, focusing on the relationship between technology and societal needs, and is generally carried out by interdisciplinary teams; the MQP is a more narrowly defined capstone design project carried out by teams specific to a major. This system soon evolved to include off-campus experiences. Today, nearly 700 IQP and 100 MQP students travel to one of roughly 40 sites around the world to satisfy their project requirements, frequently working with local project partners who have long-term relationships with faculty. One goal of the WPI strategic plan is for at least 90 percent of students (roughly 930 per year) to have an off-campus project experience; thus, a significant investment has been made in expanding Project Centers. This article discusses the work at the sites in Cuenca, Ecuador, and Panama City, Panama, to accommodate larger numbers of students and more diverse project partners, with particular emphasis on building global competencies. The logistics, types of partners and their projects, and results of initial evaluation activities demonstrate the administrative arrangements crucial in supporting the dynamic relationship between undergraduate researchers and the global community.

Keywords: experiential learning, global competency, international undergraduate research, study abroad

The Benefits of Global Competency
Over the last few decades, it has become apparent that technical competence in a given field may not be sufficient by itself for success in increasingly globalized professions (Sigma Xi 2007). As such, “global competence” as a component of undergraduate training has received a great deal of attention from academia and industry alike. In general, globally competent individuals are those who can work effectively in diverse teams with partners who hold differing perspectives, speak different languages, have different social norms or values, and approach research problems and tasks in different ways. Globally competent individuals not only have access to a greater number of professional pathways by having the skills necessary to pursue projects with a more diverse group of partners but also can produce superior results even if they remain in their home country. Wilde (2011a) writes that “...teams do better when they are composed of people with the widest possible range of personalities, even though it takes longer for such psychologically diverse teams to achieve good cooperation. They must first cultivate an openness to opposing opinions and recognize the value of exploring a problem from various angles” (see also Wilde 2011b). In the broadest terms, global competencies can be thought of as the skills that “cultivate an openness.”

A wide variety of different “global learning outcomes” have been identified, which can be grouped under three general themes. The first, and least abstract, theme emphasizes the logistical requirements necessary for interaction with transnational partners, such as skill in foreign language, understanding of local etiquette, and ability to conduct everyday affairs such as shopping or seeking medical attention. The second theme encompasses the skills necessary for productive professional integration with transnational entities so that an individual could work effectively with an organization outside of his or her home culture. The third and most nebulous theme entails a personal understanding of the complex and interrelated social, political, economic, cultural, and environmental factors in a given context in the broadest terms—how specific policies, solutions, and decisions may affect various stakeholders. Learning outcomes or skills categorized in this way are not mutually exclusive, but they can be mutually beneficial. For instance, an individual with experience working with transnational partners may be able to do so effectively by relying on an interpreter if that individual does not have foreign-language skills; however, such intermediaries may subconsciously or purposefully influence the tone, direction, and content of a conversation, thus affecting outcomes. Skill-building across all three themes, therefore, leads to a greater likelihood of success for the globally competent professional (Lohmann et al. 2006; Shen et al. 2011).

Immersive experiences off-campus, where formal instruction is supplemented with informal learning opportunities, are generally considered to be the best way to build global competencies, as they provide students with the most “authentic” experience. Too much reliance cannot be placed on informal learning opportunities, however—in one study, foreign students studying in Britain reported that most informal contact consisted of brief exchanges for the purpose...
of obtaining immediately useful information, leading to no significant increase in vocabulary (Briggs 2015). There is also no way for instructors to ensure that students do not revert to their home language outside of the classroom or rely on more experienced classmates to carry out basic activities such as shopping. Informal structured experiences, such as requiring students to carry out community projects while abroad or pairing them with conversation partners, can therefore be more effective pedagogical methods.

Although the number of people studying abroad has more than doubled in the past two decades to about 300,000 individuals per year, the average program length is declining. The Institute of International Education (2016) reports that in academic year 2014–2015, more than 60 percent of students traveled for programs of fewer than eight weeks, and only 3 percent were involved in full-year programs, down from 17 percent three decades ago. Dwyer (2004) reported that the positive benefits of study abroad programs can have an effect on an individual for as long as 50 years, even for programs as short as eight weeks, concluding that a well-planned, intensive program of short duration may be as or more beneficial than a less rigorously scheduled full-year experience. Chieffo and Griffiths (2004) reported similar results. Khoroshilova et al. (2015), in a study of Russian students participating in a mobility program, found that even a language-focused study abroad experience of as short as two weeks had a significant positive impact on student attainment of learning outcomes and their pursuit of other international activities. Parsons (2010), on the other hand, noted that students participating in a curriculum with internationalized content showed improved achievement of several learning outcomes related to global competency, even without international travel.

Global Competency and the WPI Educational System

The ability of project-based learning to build professional skills is well established. Compared to conventional lecture-based efforts, experiential learning has been shown to lead to better outcomes in areas of professional skill such as communication and teamwork, preparation for self-directed research, preparation for and pursuit of graduate studies, appreciation of the value of interdisciplinary inquiry, and understanding of specific technical concepts (Jiusto and DiBiasio 2006; Tryggvason and Apelian 2011; Vaz and Pedersen 2002). In retrospect, it is not surprising that the project-based curriculum at WPI evolved to incorporate off-campus opportunities almost immediately after it was established, enabling students to build broad global competencies in all three themes as well as in conventional professional skills. The first off-campus Project Center opened in Washington, DC, in 1974; today, more than half of WPI students meet at least one of their project requirements off-campus over the course of a seven-week term. Most of the 40 Project Centers are in the United States or Europe, although several are located in nontraditional destinations such as India, Morocco, Namibia, and Thailand. In a recent evaluation of off-campus projects, 2500 WPI Project Center alumni answered questions regarding 39 areas of long-term impact, which were followed by 25 in-depth interviews with alumni and their employers (Vaz and Quinn 2014). In projects carried out off-campus, students consistently reported achieving learning outcomes at levels significantly higher than those involving on-campus projects, with positive impact in 33 out of 39 areas.

The first required project is usually carried out during the second year by individuals, rather than teams; the Humanities and Arts (HUA) requirement culminates in an inquiry or practicum and entails either six courses with a breadth-and-depth component or six sequential foreign-language courses. Such internationally focused work can provide a good logistical foundation on which to build future experiences, aligned most closely with the first theme previously described, although few students elect an off-campus experience to fulfill their HUA requirements.

As juniors, students complete their IQP, a social science-focused project in which technical and professional skills are built in the context of specific stakeholders. Students are expected to demonstrate an understanding of the project’s technical, social, and humanistic context; define clear, achievable goals and objectives; critically identify, utilize, and integrate information from multiple sources to identify appropriate approaches to solving an interdisciplinary problem; analyze and synthesize results from social, ethical, humanistic, technical, or other perspectives, as appropriate; and effectively communicate results while maintaining working relationships with teammates, advisers, and project partners. Although it is the second project pursued by students, these learning outcomes most closely align with the third theme identified above and have been established to ensure that students develop not only professional skills but also recognize that technical solutions cannot exist outside of a social context. These outcomes are a direct reflection of the era in which the WPI curriculum was established—postwar scientific progress failed to deliver on the utopian promises of the 1950s in large part because relevant social contexts had not been factored into the implementation of technological innovations (Cullather 2002). The majority of off-campus projects are IQPs, with a Project Center usually hosting six teams of students (roughly 24 individuals) advised by two faculty members on-site. The socially oriented nature of the IQP lends itself more readily to immersion in an unfamiliar culture, which explains the preference of students for completing IQPs off campus and the general consensus of students that their IQP work has “more of an impact” than their other project work.
The MQP is generally completed during a student’s fourth year of study and focuses on applying disciplinary knowledge as a professional would in a particular field—students majoring in science perform fundamental research, engineering students develop solutions to specific technical problems, and so on. Student teams are generally organized by major, although interdisciplinary teams advised by multiple faculty members are not unusual. The specific learning outcomes and general requirements for MQP work vary by department; however, WPI faculty members have adopted a common guideline that states “… should demonstrate application of the skills, methods, and knowledge of [the student’s discipline] to the solution of a problem that would be representative of the type to be encountered in one’s career.” Only one-third of Project Centers host MQP students. Usually one team of four students is hosted at a time and is advised remotely.

WPI’s project-based curriculum embodies many of the elements that have been identified as “high-impact education practices” (Kuh and O’Donnell 2013). This is particularly true in the case of the Global Projects Program. High-impact practices have been found to produce greater gains in learning and personal development than more traditional educational practices (Kuh 2008). These gains include “deep approaches” to learning, which encompass integrating ideas and diverse perspectives, discussing ideas with faculty and peers outside of class, analyzing and synthesizing ideas, applying theories, judging the value of information as well as one’s own views, and trying to understand others’ perspectives (Brownell and Swaner 2009, 26). Working and studying abroad in a service-learning or community-based learning environment, engaging in collaborative research within teams, and intensive training and practice in writing—all high-impact practices—are the cornerstones of WPI’s international project program.

The Work of Project Centers in Cuenca and Panama City

Creating off-campus project opportunities for students requires support, expertise, and resources. A Project Center must have local support for housing, site orientations, and the identification of projects; expertise in specific areas such as academic preparation, student support, risk management, and achievement of educational goals; and adequate institutional channels to facilitate payments, contract agreements, emergency management procedures, protocols for responding to unanticipated student behavior, and so on. Composed of 11 full-time faculty members, the Interdisciplinary and Global Studies Division (IGSD) provides administrative assistance in many areas that are common to all Project Centers. Prior to departure for an off-campus IQP, all students are required to take Social Science Research for the IQP, a full-term course organized by the IGSD, that introduces the social science methodologies that students are likely to use in their projects and the culture with which they will be interacting. Students discuss both external challenges (e.g., a lack of language skills or understanding of local etiquette) and internal challenges (e.g., ways to deal with homesickness or time management). Goldstein and Keller (2015) report that although students are primarily concerned with the external challenges, internal challenges are more likely to lead to difficulties during overseas experiences.

The Project Centers in Cuenca and Panama City (two of only four Project Centers in Latin America) are no exception to the resource-intensive nature of off-campus research sites. In academic year (AY) 2016–2017, Cuenca will host its first full group of 24 IQP students, with plans to expand the site to host MQP students by AY 2018–2019. Located in a medium-sized city surrounded by many of Ecuador’s indigenous highland communities, the Cuenca Project Center was established through the efforts of a faculty member and a WPI alumnus living in Ecuador. An inaugural IQP team traveled to Cuenca in 2015 to make recommendations on the establishment of a site there. The Panama City Project Center is somewhat older, as it was established in 2009 in cooperation with an alumnus employed by the Panama Canal Authority (ACP). For the first six years, this Project Center hosted four students, advised remotely by a faculty member, each year. The students worked as ACP interns to meet their MQP requirements. In AY 2015–2016, the site accepted three IQP teams and one on-site faculty member for the first time; it is expected to reach full capacity in AY 2017–2018.

Students are required to complete a university-standard assessment questionnaire before they submit their final report. The questions on this instrument gauge student perception of the attainment of established learning outcomes, and although the sample size is small (four IQP students in Cuenca and four MQP students in Panama), the results show broad approval of the program (see Table 1). Low ratings in some of the questions about Panama City suggest student dissatisfaction with the exact nature of the technical work pursued; one student wrote in an optional comment field, “The thing that needs most improvement are the projects themselves. Some of our projects were not very technically challenging...,” yet later wrote, “If I were given the opportunity 100 times over, I would take it every time.”

The authors, site directors at the Cuenca and Panama City sites respectively, have focused their efforts on two specific logistical areas. Housing has a significant effect on student experiences. Students housed in university dormitories or hotels can become insulated from the surrounding culture and in extreme cases may have an experience similar to instruction at their home university. For this reason, although the inaugural group of students sent to Cuenca recommended a
particular hotel from among 16 choices as their preferred housing option, the decision was made to house students in local homes rented from a Cuenca resident—although more paperwork was involved than that for hotel housing. In Panama City, students are housed in the dormitories of the Ciudad del Saber, a research campus organized by a nonprofit group. Situated in a former army installation turned over to the Panamanian government at the end of the American military occupation of the Canal Zone in 1999, the Ciudad del Saber campus houses offices for numerous NGOs and universities, entertainment venues, medical facilities, supermarkets, and restaurants as well as offers frequent cultural festivals, lectures, and demonstrations open to the public. Student assessment revealed broad satisfaction with the housing, although frustration with slow Internet service and the lack of access to an oven for cooking was expressed. Anecdotal comments suggest that the students were not so much frustrated by the lack of these amenities but rather by a lack of information about these matters prior to their arrival in the host country. In response, the Panama City site manual was updated to include comprehensive information about cooking techniques appropriate for tropical countries.

Engaged project partners willing to meet with students in person and to mentor projects with potential for tangible effects on the community are more likely to encourage students to take ownership of their projects, leading to better achievement of learning outcomes. In Cuenca, project partners for AY 2016–2017 IQPs include the government council in a village outside of Cuenca that is interested in planning eco-tourism facilities; a university-based organization that addresses nutrition and food security; and a community development organization that seeks to promote healthy, safe, and economically autonomous ways of life for at-risk women and children. Similarly, the IQP projects pursued in Panama City are based on partnerships with an NGO working to expand access to potable water in the Cerro Patacon informal settlement and a university-based group seeking to expand economic opportunities in western Pan-

Table 1. Evaluation Results from Initial Projects in Cuenca and Panama City

<table>
<thead>
<tr>
<th>Evaluation results for IQP Students in Cuenca, Ecuador</th>
<th>Mean Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning how to set and meet goals for research and projects</td>
<td>5</td>
</tr>
<tr>
<td>Learning how to find and use information resources</td>
<td>4.75</td>
</tr>
<tr>
<td>Learning to analyze and critically evaluate ideas and information</td>
<td>5</td>
</tr>
<tr>
<td>Developing skill in expressing oneself in writing</td>
<td>4.5</td>
</tr>
<tr>
<td>Developing skill in expressing oneself orally</td>
<td>3.75</td>
</tr>
<tr>
<td>Acquiring skill in working with others as a member of a team</td>
<td>5</td>
</tr>
<tr>
<td>Overall, my level of effort on this project was</td>
<td>4.75</td>
</tr>
<tr>
<td>Overall, I rate my learning from this project as</td>
<td>4</td>
</tr>
<tr>
<td>The intellectual challenge presented by the project was</td>
<td>5</td>
</tr>
<tr>
<td>The project’s overall value as an educational experience was</td>
<td>5</td>
</tr>
<tr>
<td>Each week, I worked on average the following number of hours</td>
<td>48.75</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Evaluation results for MQP Students in Panama City, Panama</th>
<th>Mean Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applying fundamental and disciplinary concepts and methods specific to my major</td>
<td>3.75</td>
</tr>
<tr>
<td>Demonstrating skill and knowledge of current technological tools and techniques relevant to my major</td>
<td>3.5</td>
</tr>
<tr>
<td>Developing skill in written communication</td>
<td>5</td>
</tr>
<tr>
<td>Developing skill in oral expression and public speaking</td>
<td>4</td>
</tr>
<tr>
<td>Developing skill in visual communication (i.e., use of images and graphics to convey information, data, and ideas)</td>
<td>4</td>
</tr>
<tr>
<td>Identifying, analyzing, and solving problems creatively through sustained critical investigation</td>
<td>4</td>
</tr>
<tr>
<td>Finding, critically evaluating, and integrating information from multiple sources</td>
<td>5</td>
</tr>
<tr>
<td>Understanding and applying ethical standards in my field (e.g., human and animal rights in research, respect for intellectual property, social and environmental responsibility, honest reporting of data, sensitivity to conflict of interest)</td>
<td>4.5</td>
</tr>
<tr>
<td>Taking responsibility for my own learning and project direction</td>
<td>5</td>
</tr>
<tr>
<td>My progress in working with others as a member of a team was</td>
<td>4.75</td>
</tr>
<tr>
<td>The intellectual challenge presented by the project was</td>
<td>3.75</td>
</tr>
<tr>
<td>The preparation for the MQP experience provided by courses in my major was</td>
<td>4</td>
</tr>
<tr>
<td>The preparation for the MQP experience provided by earlier WPI projects was</td>
<td>5</td>
</tr>
<tr>
<td>The project’s overall value as an educational experience was</td>
<td>4.25</td>
</tr>
<tr>
<td>Overall, my level of effort on this project was</td>
<td>4.5</td>
</tr>
<tr>
<td>Overall, I rate my learning from this project as</td>
<td>4.25</td>
</tr>
<tr>
<td>On average, how many hours per week did you spend on this project</td>
<td>47.5</td>
</tr>
</tbody>
</table>

Note: Unless otherwise noted, the scale is from 1 (low/did not achieve at all) to 5 (high/exceptional achievement).
ama, a region that has seen little benefit from the massive revenues produced by the Panama Canal. To have students at both sites interact with individuals who are not only from a different country but also from radically different socio-economic conditions was intentional—Parsons (2010), based on responses from 1302 study abroad participants, suggested that students achieve learning outcomes at a higher level if they work in developing countries rather than in industrialized nations. Although the origin of this improved achievement is unclear, the authors of this article believe that it is most likely due to the extra effort expended by a student to “cultivate an openness” to the perspectives of project partners representing dimensions of diversity beyond language and nationality, which results in improved motivation and ownership of the learning experience.

Cuenca does not yet host MQP students; MQP students in Panama City work with the ACP, primarily the Water Division and the Engineering Vice Presidency. Projects focus on technical design work, such as locating grout curtains for the Boriquen 1E Dam, making calculations related to the dredging of approach channels for the Third Set of Locks Project, or analyzing water quality aboard ACP-owned tugboats. Some projects, however, have included social components, such as one that analyzed shoreline management policies for Lake Gatún that would safeguard the ecosystem while maintaining existing populations. As a student could easily become isolated from the community and broader learning experiences in such a professional setting, two additional activities are carried out to encourage students to interact with the host culture. The first is a one-week orientation course at a Spanish-language school in Panama City, of which one student wrote, “[I] learned more conversation in that week than I had in 8 years of classes,” and another confided, “[I] wouldn’t have made it in Panama as well as I did without it.” The second activity is a group “cultural excursion” to a destination of the students’ choosing, which most recently entailed a visit to the San Blas islands, an autonomous district administrated by the indigenous Guna Yala peoples. It should be noted that the lack of an on-site faculty member supervising the team does not seem to have been a handicap; one student wrote, “I think that the most important thing that I learned from this experience was that I can, like, adapt to new things with reasonable time ... I definitely learned that I could do that by myself without, you know, having my parents help me and people here help me.”

Conclusions
As directors of off-campus project centers, the authors of this article view supporting undergraduate research in the global community in terms of opposing costs. Although developing the skills necessary to work effectively with partners of diverse backgrounds can lead to superior professional success for students in any given field, there are no simple answers regarding the methods for building these skills in students. In addition, significant investments in time, expertise, and resources are required to build effective programs. Students in programs that do not foster interaction with the host society are unlikely to achieve their learning objectives at any higher level than their peers at home; such success comes at the cost of the annoyances and frustrations of day-to-day life outside of an individual’s primary language and culture. Connecting on a personal level with those of different socio-economic backgrounds can be difficult for many students, but diversity is not limited solely to the nationality of project partners. The intentional selection of logistical arrangements like those described here can shape the relationship between undergraduate researchers and the global community, regardless of the size, length, or educational goals of a program.

Acknowledgments
The authors would like to thank the staff of the IGSD as well as the National Science Foundation’s Office of International Science and Engineering, which supports activities in Panama through grant #1357667, “Environmental Impact of the Panama Canal Expansion Project.”

References
10.1016/j.sbspro.2015.11.691.


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Laureen Elgert, an assistant professor of social science and policy studies at WPI, focuses on the environment-development nexus, examining how politics shape global environmental policy that can (and often does) have profound impacts on local livelihoods. Elgert has worked on a UNESCO Man and Biosphere Program site in the Interior Atlantic Forest (Paraguay), where she helped facilitate the emergence of local and regional governance institutions. She has also researched environmental politics in the context of soy production in South America, with particular focus on the development of “sustainable soy” certification criteria, and has served as site director of the Ecuador Project Center since 2015.

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Undergraduate Learning from the Ground Up: Linking Belowground and Aboveground Diversity in Costa Rica

Abstract

Through a grant from the National Science Foundation's Research Experiences for Undergraduates (NSF REU), 24 undergraduates (more than half from underrepresented demographic groups) addressed ecological and natural resource management questions within the Maquenque National Wildlife Refuge between 2013 and 2015. Students worked with faculty mentors and researched vegetation, invertebrates, primates, soil microbial community structures, or soil biogeochemical characteristics within a variety of undamaged, damaged, or at-risk habitats. This article highlights some studies conducted by students that sought to provide new ecological information to Costa Rica's Research and Monitoring Plan. Development and diversity are compared within a variety of sites, including selectively harvested forests, 10- to 30-year-old regenerating secondary forests, silviculture plots, and recent agriculture sites that were left fallow. Outcomes in student learning, scientific growth, and ability to connect personal research to that of others are presented. The research experience encouraged the students to become scientists with a global perspective in ecology and environmental sciences, and provided data that can be used for future land management and educational purposes.

Keywords: Costa Rica, ecology, environmental science, fieldwork, lowland wet forests, nutrient dynamics, NSF REU

Introduction

Within the ecological and environmental sciences, research is often conducted in a controlled setting, and information is presented without reference to other disciplines or to a larger socioeconomic context. Such approaches are usually not effective for students from underrepresented groups whose cultures may emphasize learning through direct engagement, a multidisciplinary perspective, and active learning (Armstrong et al. 2007, 415–420; Committee on Undergraduate Biology Education 2003, 10–14; Brewer and Smith 2011, 2–6). It is no surprise, therefore, that the people hired as ecologists and environmental scientists in the United States reflect a very low level of diversity, as indicated by the Ecological Society of America (Armstrong et al. 2007). Additionally, traditional approaches in undergraduate biology education often fail to instruct students in the practice of science, leaving majors ill-prepared to perform well early in their career (Committee on Undergraduate Biology Education 2003, 10–14; Brewer and Smith 2011, 2–6). As a response to these concerns, a program under the National Science Foundation’s Research Experiences for Undergraduates (NSF REU) was designed to emphasize the development of independent, yet team-based, transdisciplinary undergraduate research within an important international conservation area.

The NSF REU programs support “meaningful participation by undergraduate students in most areas of research in science and engineering” (Beninson et al. 2011). NSF funds approximately 700 REU programs annually, with 7000 student participants in scientific disciplines at various universities each year. Sponsored sites manage cohorts of undergraduates who usually conduct summer research projects at a host university in the United States (Rorrer 2016). As reported by Beninson and colleagues (2011), few REU sites exist in international locales, and the number of these programs has decreased since 2006. A few REU programs supported by the NSF Directorate for Biological Sciences are hosted in the tropics such as those through the Organization for Tropical Studies at the La Selva Biological Station in Costa Rica (http://www.ots.ac.cr/) and the Smithsonian Tropical Research Institute in Panama (http://www.stri.si.edu/reu/english/). These programs emphasize that students reside within an academic community with many other researchers. The REU discussed here was unique in that it involved a study abroad immersive experience, with participating students and faculty members as the only researchers studying the ecology of the remote site, and the research was designed to assist in local land management decision making. Equally significant was the emphasis on community service and social activities that connected participants to the peoples of Costa Rica.

From 2013 to 2016, this REU offered 24 undergraduates the opportunity to conduct research while helping a rural community in northern Costa Rica and supplying information that can be applied to management protocols. Short-term study abroad experiences can provide undergraduate students with the chance to develop intercultural knowledge, skills, and attitudes that are essential in this age of globalization (Czervionka et al. 2015, 80–81). Nationally, the demographic profile of students studying abroad does not match the demographic profile of U.S. undergraduates. The Institute of International Education (2016) estimates that 27 percent of students studying abroad are from a minority background:
Hispanic or Latino Americans, African Americans, Asian or Pacific Islander Americans, and Native Americans. This proportion represents a modest increase from the estimated 17 percent of students studying abroad in 2005. The REU Sites programs supported by the NSF Directorate for Biological Sciences typically engages a diverse group of undergraduates, with more than 40 percent of participants coming from underrepresented ethnic groups (around 20 percent of whom are Hispanic), and approximately 62 percent of participants across all biology REU programs are female (Beninson et al. 2011). The biology REU program discussed here had a greater proportion of underrepresented groups and women than the averages reported by Beninson et al. (2011), with women composing approximately 80 percent of participants, and Hispanic or African American individuals composing more than 65 percent of participants. Although most of the participants were sophomores or juniors when they were REU participants, more than 70 percent did not have previous research experience or had minimal exposure to research. Furthermore, 88 percent of the students had never conducted research outside of the United States.

This REU program provided a unique research opportunity that enabled the participants to become stronger scientists while developing their knowledge of tropical ecology and cultural awareness. The goals were to help REU students develop enhanced scientific creativity and critical thinking, an interdisciplinary and global perspective on the environmental-related sciences, excellent scientific skills, knowledge and technological expertise, and a better understanding of tropical rainforest conservation issues. There is arguably no greater way to understand the complexity of the rainforest than to discover it personally through immersive research. A model of undergraduate research was created in which students worked with faculty mentors to conduct field projects with potential to influence land management decisions in one of the world’s most biologically diverse ecosystems. The structure and outcomes of this unique learning and research opportunity are discussed below.

This project’s fieldwork provided an unparalleled opportunity to investigate environmental dynamics that occur as an ecosystem recovers following disturbance. These dynamics are extraordinarily complex in the lowland wet forests of northern Costa Rica, where 70 percent of the forests have been cleared for agriculture or pasture over the past 40 years (Schelhas and Sanchez-Azofeifa 2006). Although significant conservation efforts have been made, biodiversity loss in Costa Rica continues as forest ecosystems are converted into agricultural fields, plantations, and pastures (Shebitz and Eaton 2013; Looby and Eaton 2014). The San Juan-La Selva Biological Corridor was established in 2001 with the goal of protecting the remaining diversity. This corridor links six protected areas to form a large 1,204,812ha. unit. The Maquenque National Wildlife Refuge (MNWLR) is considered the principal conservation area within the corridor (Eaton and Chassot 2012, 187).

The study site is in one of the most remote and underdeveloped parts of Costa Rica, approximately 9 kilometers outside of the town of Boca Tapada (population approximately 250) and 20 kilometers south of the Nicaraguan border (latitude: N 10°40’13.68". longitude: W 85°45’43.15"). This area has only been accessible by land vehicles since 1970, and electricity was made available in 1994 (Marshal et al. 2011, 17). Lodging and food were provided by an eco-lodge, Laguna del Lagarto, whose staff has become close friends of the faculty and students involved with this project. The lodge’s property includes 500 hectares of lowland wet forest characterized by high plant and animal diversity, set within a matrix of primary and secondary forests, grasslands recovering from grazing, and agricultural fields. William Eaton (the project’s co-principal investigator) has conducted research at this location since 2002. In an effort to promote the lodge’s continued use for scientific research, the owners of Laguna del Lagarto built a temperature-controlled laboratory that was used by this project.

The Structure of the REU Grant Program

To address ecological and natural resource management questions for the MNWLR, eight NSF REU students worked closely each summer with one of seven faculty mentors to research the vegetation, invertebrates, reptiles, primates, soil microbial community structures, or soil biogeochemical characteristics within a variety of damaged, damaged, or at-risk habitats. Students were selected primarily based on their statement of purpose relating to their interest in field research and letters of recommendation that referred to the students’ ability to adapt to new situations and work as part of a team. Of particular interest was participation of students from underrepresented ethnic backgrounds, and between four and eight Latino or African American students participated every year. As more than 275 students applied during the last year, deciding on eight candidates was exceptionally difficult.

The program took place over 10 weeks each summer (see Table 1), with the first two weeks of work conducted at Kean University in New Jersey where the students worked with their mentors to learn about the location in Costa Rica, develop possible research questions and methods, practice field techniques in temperate forests, and become familiar with the scientific literature. Collecting and reading scientific literature in advance were extremely important, since there is not reliable Internet access at the field site.

A large group of faculty mentors and students then traveled to Costa Rica, where the undergraduate students and a PhD student mentor stayed at the field location for six weeks. The
Table 1. A Generalized Schedule for the Tropical Ecology NSF REU Project Run through Kean University

<table>
<thead>
<tr>
<th>Week</th>
<th>Location</th>
<th>Focus Activity</th>
<th>Skill Developed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1–2</td>
<td>New Jersey</td>
<td>Literature review</td>
<td>Scientific reading</td>
</tr>
<tr>
<td>2</td>
<td>New Jersey</td>
<td>Develop research project concept</td>
<td>Developing research questions</td>
</tr>
<tr>
<td>3</td>
<td>Costa Rica</td>
<td>Introduction of field sites, methodology developed at study location</td>
<td>Observation and hypothesis generation</td>
</tr>
<tr>
<td>4</td>
<td>Costa Rica</td>
<td>Finalize study design and install plots/transects; initiate data collection</td>
<td>Experimental design</td>
</tr>
<tr>
<td>5–8</td>
<td>Costa Rica</td>
<td>Collect data in the field</td>
<td>Data collection</td>
</tr>
<tr>
<td>5–8</td>
<td>Costa Rica</td>
<td>Laboratory analysis for some projects (i.e., DNA extraction, plant biomass, soil chemical analysis, insect identification)</td>
<td>Laboratory skills specific to research area</td>
</tr>
<tr>
<td>7</td>
<td>Costa Rica</td>
<td>Work on community service project</td>
<td>Cultural awareness</td>
</tr>
<tr>
<td>9–10</td>
<td>New Jersey</td>
<td>Analyze data</td>
<td>Data analysis</td>
</tr>
<tr>
<td>10</td>
<td>New Jersey</td>
<td>Present research in a scientific format to the REU group and others</td>
<td>Presentation skills and scientific writing</td>
</tr>
</tbody>
</table>

In addition to these activities, soccer games and canoe rides were scheduled with community residents, and members of the women’s association taught the students how to prepare local dishes. These activities were not just designed to help the local community but also to enrich the cultural knowledge and sensitivity of the undergraduates.

After the students returned to New Jersey, they worked with their faculty mentor during the project’s final two weeks on analyzing data and preparing presentations or publications based on their research. As a final step, the students presented their research to faculty members of Kean’s School of Environmental and Sustainability Sciences, friends, and family.

A Summary of the Science

Although a Research and Monitoring Plan for the MNWLR exists that intends to provide baseline data on the condition of the lowland wet forest ecosystems, Costa Rica has not dedicated funds to implement this plan. The MNWLR offers a rare and rich opportunity for REU students to provide new ecological information to the Research and Monitoring Plan. The development and diversity were compared within a variety of sites, including selectively harvested forests, 10- to 30-year-old regenerating secondary forests, silviculture plots, and recent agriculture sites that were left fallow. One of the great opportunities in these studies is that students were making “apples to apples” comparisons, as all study sites were originally part of the same uplands primary forests in the region, with the same topography and soil types. This situation is rarely available in comparative ecosystem studies.

Student participants in the REU worked with their faculty mentors to design a research project that was possible to accomplish within the allotted time and with the field/lab equipment available. Three projects are highlighted below that sought to develop the scientific skills of the students as well as address the cultural and environmental needs of the MNWLR.

Effects of Land Management on the Availability and Ecology of Medicinal Plants. Because of its proximity to the Costa Rica-Nicaragua border, the community of Boca Tapada has a blending of the cultures of these two countries. Since a nurse or medical student only visits the village once a month, plants provide an essential and reliable source of medicine for the local population. Changes in forest cover, however, are influencing the availability of plants used to treat ailments ranging from skin and gastrointestinal infections to diabetes and cancer. Students documented commonly used medicinal plant species in the MNWLR based on interviews with local healers and began to understand the knowledge arising from Nicaraguan immigration into this remote section of Costa Rica. Many plants that are sources of medicine are found in secondary or primary forests based on their ecological re-
requirements. Students studied the abiotic and biotic factors that affected the growth of some of these plants (focusing primarily on the following medicinal trees that are used to treat infections: *Visnia macrophylla*, *Pentaclethra macroloba*, and *Simarouba amara*). In addition, some students evaluated the medicinal efficacy of plants identified in interviews based on a triplicate disc diffusion assay that tested effects of plant extracts against bacteria and fungi. By working with the local people on documenting their knowledge and uses of plants, the project sought not only to empower the elders in the community but also to inspire the youth of Boca Tapada to learn from their elders and continue to appreciate the relationships between the forest and the people in that region.

**Linking Soil Chemistry to Plant Diversity in Primary and Secondary Forests.** Soil composition, physical properties, and chemical nutrients in primary and secondary forests within the MNWLR were characterized and compared to understand the human impact of disturbance on the ecosystem. Students examined the role of early successional leguminous trees in recovering nutrients and enhancing the development of the soil’s physical and chemical properties. Chemical analysis and soil data were used to elucidate the possible microbial reactions within the different types of the forests. Students linked the dynamics of the beloground system to changes in plant diversity and cover aboveground in disturbed and intact environments of the MNWLR and showed the importance of nitrogen (N)-fixing trees to the ecosystem recovery following disturbance in the region. This work is particularly important in documenting the role of *Pentaclethra macroloba* as the dominant N-fixing pioneer tree species in the lowland wet forests studied. Although there is increasing pressure on this species as a source of lumber in the region, it is hoped that this work highlighting the ecological importance of *P. macroloba* will be used as a call for its conservation through the MNWLR land management plan. As the students have documented, this species transforms the soil and plant communities in secondary forest and plays a pivotal role in forest recovery following agricultural clearing.

**A Comparison of Soil Carbon and Nitrogen Cycle Dynamics, and Fungal and Bacterial Community Composition Associated with Different Ecosystems and Land Management Strategies.** The MNWLR is one of the most important areas in the Northern Zone of Costa Rica where different land management strategies and restoration activities are attempted. This project involved comparing soil ecosystems between differently managed lands with that of the adjacent intact primary forest. Comparisons were made among primary forest, 18-year-old secondary forest, 30-year-old secondary forest, various ages of grasslands, and various ages of silviculture plots planted with an indigenous tree (*Vochysia guatamalensis*). Also compared were the soil ecosystem communities associated with two different leguminous tree members of the family Fabaceae (*Inga edulis* and *Pentaclethra macroloba*) in some of these habitats. Soil was collected from replicate plots and tested for carbon and nitrogen cycle metrics and biomass levels. DNA was extracted and outsourced for next generation sequencing, leading to the production of millions of bacterial and fungal DNA sequences that were used to identify microbial taxa within the different habitats. Students analyzed the nutrient and biotic data to determine effects of different land management strategies and to propose biotic drivers of ecological processes in these soils. This study was designed to determine best methods of managing grasslands resulting from forest clearing in terms of carbon use efficiency and economic benefit for the land manager. The students’ work showed that 12-year-old *V. guatamalensis* planted in grasslands increased the flow of CO₂ into soil, improved biomass recovery, and resulted in a soil ecosystem that was more complex than unplanted grasslands. This management strategy resulted in soil ecosystem enhancement that was similar to soils of 18-year-old secondary forests that were allowed to regenerate naturally. The local land owner is now planting all of these grasslands with *V. guatamalensis* so that sections can be harvested annually in 10–12 years. He is also encouraging other land owners in the area to do the same so that income sustainability and benefit to the environment can be accomplished. This management decision would not have been possible without evidence provided by the undergraduate researchers.

**Learning Outcomes**

Outcomes of the program were assessed through a survey completed by 19 of the 24 participants (79-percent response rate). The results clearly indicate that participation in this REU program inspired students, developed their skills as scientists, and helped them develop a global perspective in ecology. Part of the survey included a series of questions regarding gains made in understanding the importance of cultural dynamics and ethics when conducting international research projects. An average of 4.4 out of 5 was selected on all of the questions (see Figure 1).

More than 90 percent of the students answered that their awareness of the Costa Rican culture and their understanding the importance of ethics when working with different cultures significantly improved after completing the REU program. For example, one student wrote:

- **My worldview view has definitely changed... It was great to learn about their country and the traditions they held. It made me value the importance of learning about how others live and discovering different parts of the world.”**

Another student stated:

- **“Working in an international community provided me**
with a different perspective other than my own and broadened my horizons in numerous ways. It helped me gain a greater understanding of other cultures, particularly in regards to conservation efforts in Costa Rica and the importance of the resources located there.”

The connection to Costa Rica felt by the students extended beyond the people to the environment. One participant reported:

- “The best part was just being surrounded by rainforest. This gave me a better appreciation for the land, an appreciation that can’t be gained from books or shows.”

One essential element of this project was that the scientific information gained can be used to preserve the very ecosystems being studied. As one participant stated:

- “[T]his research opportunity in Costa Rica was immensely impactful in that I was able to see that the research I was doing could potentially benefit the ecosystems in which I was collecting data. Furthermore, by going out into the rainforest and collecting data in the field, I gained greater appreciation for how data are collected.”

The role of the REU experience in influencing students to identify as scientists was evident throughout many survey responses. Notably, responses averaged 4.5 out of 5 (between “a great deal” and “an exceptional amount”) when students were asked about the influence of the program on their appreciation of the connections between scientific disciplines. For example, a participant stated:

- “One aspect that encouraged me in my aspirations to study ecology in graduate school was witnessing the collaboration between the different disciplines of ecology; that made me particularly excited about working in a graduate school environment.”

Students were asked to indicate how this experience affected their confidence as a scientist and consistently rated each of the following between 4 (“A great deal”) and 5 (“An exceptional amount”) in terms of how the experience affected their level of confidence, with an average of 4.3:

1. Knowledge of how to collect and analyze data from the field and laboratory,
2. Appreciation of the connection between scientific disciplines,
3. Ability to formulate a research question and design methods to collect data, and
4. Ability to identify limitations of research methods and designs (see Figure 2).

**Figure 1. Student Learning Outcomes Assessing to the Effect of the REU on Student Understanding of the Value of Cultural Dynamics and Ethics in Conducting International Field Research Projects**

<table>
<thead>
<tr>
<th>Mean Values</th>
<th>Awareness of the Costa Rican cultural background</th>
<th>Understanding the importance of ethics and the responsible conduct of research when working with a different culture</th>
<th>Willingness to work with different cultures</th>
<th>Inclination to travel abroad and conduct research with global partners</th>
</tr>
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<tbody>
<tr>
<td>5</td>
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<td>0</td>
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Note: For the Y-axis scale, 0 = Not at all, 1 = A little, 3 = A lot, 4 = A great deal, 5 = An exceptional amount

**Figure 2. Student Learning Outcomes Assessing to What Extent the REU Experience Affected Student Confidence and Skills as a Scientist**

<table>
<thead>
<tr>
<th>Mean Values</th>
<th>Understanding how data are collected in the field and laboratory</th>
<th>Appreciation of connection among different scientific disciplines</th>
<th>Learning how to formulate a research question that could be answered with data</th>
<th>Learning how to identify limitations of research methods and designs</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
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Note: For the Y-axis scale, 0 = Not at all, 1 = A little, 3 = A lot, 4 = A great deal, 5 = An exceptional amount
Throughout the 10 weeks, students were able to experience an entire project from creation to completion, and many of them continued to work throughout the rest of the year to present their information at conferences or write manuscripts for peer-reviewed journals. As one student stated:

- “Conducting research is complex. There is a crucial balance between big picture thinking and analysis and detail-driven data collection. Teamwork is also very important. My hands-on experience taught me the challenges and rewards of conducting research—insights most scientists don’t get until graduate school.”

More than 70 percent of participants indicated that the research experience that they gained during the program increased their interest in ecology and encouraged them to apply for a scientific graduate program. In fact, 10 of the REU participants (seven of whom are from underrepresented ethnic groups) have started a science-based graduate program or have indicated a plan to pursue a graduate career in the next two years. One of the Hispanic REU participants who would like to gain experience before entering a graduate program mentioned:

- “I plan on joining the Peace Corps and then working towards a graduate degree in ecology. Throughout my future, I will continue to share lessons I learned through the REU with those from diverse ethnic groups so that I can inspire people of various backgrounds to pursue careers in the environmental sciences.”

Another REU participant from an underrepresented ethnic group explained:

- “My research experience made me confirm that science is the field for me. I gained so much from the process of coming up with a research question, troubleshooting issues along the way, feeding off of others’ ideas, and working long, exhausting hours. It was all so worth it. I felt so accomplished at the end of the REU program and knew that I had grown so much. I was pushed outside of my comfort zone and made to think deeper and harder. For that, I am so very grateful. This program made me realize exactly what the field of science has to offer. With research, there is still room to ask questions that fascinate you and work hard to get answers. It is that sense of passion that I felt while at REU that has propelled me toward my future goals.”

The REU program also gave participants an opportunity to significantly improve their interpersonal and professional skills. They were asked about their current level of comfort working in groups, and they all responded either feel good (4 out of 5) or excellent (5 out of 5) working with a team and local community members after completing the REU program. In fact, when asked about the best part of the experience, 10 students answered in terms of their connections with the team of their peers, their mentor, and the locals. For example, one student responded:

- “The best part of the REU was the friendships I made along the way, both with the other members of our research team and the locals we meet.”

Another student replied:

- “Working with my peers and professors throughout this experience was hugely rewarding, and I have referred back to our group dynamic as an example of a hugely positive work experience many times since.”

Conclusion

An essential part of this REU program was the international scientific experience for students. This critical educational component helped the undergraduates develop a deeper understanding of the global nature of environmental science and an appreciation of different cultures. This type of life-changing event is often missing in the education of U.S. students. According to the Commission on the Abraham Lincoln Study Abroad Fellowship Program (2005, ii), “What nations don’t know can hurt them. The stakes involved in study abroad are that simple, that straightforward, and that important. For their own future and that of the nation, college graduates today must be internationally competent.” The authors believe that every student, regardless of economic or ethnic background, should be encouraged to study abroad and that taking part in international field research provides an unparalleled opportunity for young adults to develop a truly ecological and cultural worldview. It was hoped that this part of the REU program would serve as a “tipping point” experience to inspire these students to pursue the ecological sciences, as they experienced its value to the scientific and public communities and realized that it was part of an attainable career—all critical factors in attracting students from underrepresented groups into environmental science.

Acknowledgments

This project was supported by the National Science Foundation through the Research Experiences for Undergraduates program under award number 1262907. The authors gratefully acknowledge Kean University’s Office of Research and Sponsored Programs for supporting this research and assisting with grant management.

References


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doi: 10.18833/curq/37/3/3
Undergraduate Research in International Settings: Synergies in Stacked High-Impact Practices

Abstract
Research suggests that engaging undergraduates in authentic research experiences is a high-impact practice that can transform the undergraduate experience and set students on a track for success in their academic trajectory and beyond. Global learning and international experiences can similarly transform undergraduate education. This article explores two high-impact international and service-learning opportunities offered to undergraduate students, their outcomes, and the powerful combination (or “stacking”) of these two practices. Examples are discussed from study abroad programs in the natural and social sciences that infuse rigorous, authentic undergraduate research experiences as well as synergies that can occur when undergraduates engage in research in an international setting. Interactions between these experiences and specific disciplines as well as commonalities among undergraduate research and international experiences may pay dividends for programs that combine such areas.

Keywords: globalization, high-impact practices, science, service learning, social science, study abroad, undergraduate research

Introduction: Engaging Undergraduate Students in Research and International Service Learning
Engaging undergraduate students in high-impact practices (HIPs) such as research and service learning is now a widely accepted and implemented strategy aimed at improving academic and developmental outcomes (Kuh 2008; Waiwaiole et al. 2016). We know less, however, about the potential for enhancing the positive outcomes typical of these types of HIPs by carrying them out in international settings. This article explores the potential for combining HIPs in an international setting, focusing on international research experiences in the natural and social sciences. Possible synergies are discussed and ways are suggested in which the effectiveness of these types of engagement practices can be bolstered, with special reference to cultures of research on home campuses.

To explore these ideas, two case studies are offered from study abroad programs grounded in rigorous, authentic undergraduate research experiences, discussing synergies that may occur between an international study experience and undergraduate research. These programs, which are centered on the natural and social sciences, combine HIPs in several ways. Furthermore, possible interactions between these experiences and specific disciplines are explored. Engagement in undergraduate research is still overwhelmingly skewed toward the natural sciences with some studies indicating that undergraduates engage in natural sciences research three times as much as they engage in social science research (Bowman and Jennings 2005). Research experiences conducted in international settings may be a way forward to offset such imbalances, and the powerful applied context of many international research projects may help to level the playing field among disciplines (Eagan et al. 2011; Healey and Jenkins 2009).

The Challenges and Promise of Stacking High-Impact Practices
Increasing evidence from higher education research suggests that engaging undergraduates in authentic research experiences is a highly effective HIP that can transform the undergraduate experience and set students on a track for success in their academic trajectory and beyond (Kinkead 2003; Salazar 2013). However, a significant challenge is the investment in the creation, development, and consolidation of programs and opportunities for research that are framed both in sound disciplinary grounds and in training practices that are compatible with the level of maturity and experience of undergraduate students. Here these issues are explored in two ongoing international experiences led by the authors in different disciplinary realms at California State University, Monterey Bay (CSUMB).

A suite of recent studies have identified and explored transformative practices that are highly effective and powerful enablers of successful undergraduate experiences. Kuh (2008) describes high-impact educational practices as those that enable students to not only earn higher grades but also to retain, integrate, and transfer newly gained skills and competencies at comparatively high rates. High-impact practices include first-year seminars, learning communities with common courses, writing-intensive courses, internships, and capstone projects and courses. Discussed here are three more: undergraduate research, global learning, and service learning.

Undergraduate research is a high-impact practice that arguably presents universities with challenges as well as opportunities, as it requires campus-wide cultural and structural support. Bolstered by decades of renewed focus on active learning and “discovery guided by mentoring” (Boyer Com-
mission 1998, 15; Kinkead 2003), undergraduate research helps students create vibrant intellectual identities, boost their self-efficacy, and place their curricular studies in context. There also is mounting evidence that global learning and international experiences can similarly transform undergraduate education (Kuh 2008).

The success of undergraduate research programs relies on widespread campus cooperation. As noted in the recommendations of Larson (2012) from the Council on Undergraduate Research, undergraduate research requires the creation of synergies with existing high-impact practices and multiple campus constituents as well as the generation of funding sources for existing and emerging undergraduate research programs. It also requires faculty commitment to the effort as a customary part of their workloads; more important, it requires that undergraduate research be built organically and explicitly into the curriculum (Rowlett et al. 2012).

Another HIP that has received increased attention over the last few decades is global learning. Many colleges and universities now emphasize courses and programs that help students explore cultures, life experiences, and worldviews different from their own. These studies—which may address U.S. diversity, world cultures, or both—often explore “difficult differences” such as racial, ethnic, and gender inequality or continuing struggles around the globe for human rights, freedom, and power. Frequently, experiential learning in the community and/or study abroad augment intercultural studies. Exposure to diverse cultural and/or geographic environments can bolster cultural competencies and an appreciation for and sensitivity to issues pertaining to diversity and sustainability; it can also pay dividends in terms of intellectual development (McKeown 2009; O’Rear et al. 2012).

Because many undergraduate curricula have vigorously embraced HIPs, it is not uncommon for students to engage in two or even three high-impact practices during the course of their undergraduate experience. Undergraduates now often experience layering (or “stacking”) of multiple HIPs across different years/stages of their college tenure; less often, these HIPs are stacked simultaneously. Although the positive effects of individual HIPs are increasingly well documented and understood, tremendous gaps in knowledge about the effects of multiple HIPs when stacked still persist. Of particular interest is how multiple HIPs interact—are they related in a linear manner, interchangeable in time and sequence, or do synergies occur when certain HIPs are combined? In the case of undergraduate research and international experiences, there are clear areas of overlap that may enhance the student experience (see Figure 1). To illuminate these issues, two programs featuring stacked HIPs are discussed below.

Experiences in the Natural Sciences: An International Field Ecology Course in the Neotropics

Undergraduate research experiences in the natural sciences are an increasingly common element of active-learning, student-centered curricula. Arguably the most familiar type of undergraduate research experience, natural science research programs often provide opportunities for students to gain experience in fieldwork and theoretical analyses of concrete scientific challenges. Field ecology offers the added promise of placing research firmly into the context of local communities; in the best scenarios, challenges tackled are relevant and important to local stakeholders, and elements of participatory research can be included. In all cases, strong connections to local communities and an understanding of cultural and socioeconomic issues as well as the natural world are all essential aspects of the planning and implementing stages.

A field-research program deliberately incorporates undergraduate research and elements of other high-impact practices into a study abroad experience. The program originated and operated for more than a decade at the University of Washington’s Tacoma campus; it was eventually combined with a similar existing course at CSUMB. The program incorporates a combination of guided group research projects and independent research projects conducted by undergraduates mentored by faculty. These authentic research experiences have been primarily conducted in the small agrarian village of Mastatal on the Pacific slope of Costa Rica. The town has a church, a soccer field, a cantina, a community center, and a library. Most of its approximately 100 residents engage in some kind of subsistence agriculture. Mastatal abuts La Cangreja National Park, which was converted from a reserve to a national park in 2002. The region, part of “El Paseo de Las Lapas” (the Path of the Scarlet Macaws), is a component of a larger wildlife greenbelt extending the length of Costa Rica.
and of a larger biological corridor that runs the length of the Mesoamerican isthmus. Conservation/restoration efforts in the region around Mastatal have lagged behind the rest of the country; clear-cut sections of forest on the slopes of the mountainous La Cangreja National Park can still be seen, along with pastures of grazing cattle; more recently, monocultures of exotic palm trees grown for palm oil have cropped up on the outskirts of the village. In the past 15 years, several learning centers on sustainability have been established in the Mastatal area, attracting short- and long-term volunteers as well as providing an appropriate setting for studying environmental sustainability and restoration.

Research Methodology and Applications. The program was designed to foster several outcomes in student learning, such as capability in applying critical thinking to environmental challenges as well as skills in field research methodology and statistical tools. Moreover, the course’s metacognitive approach to increasing the transfer of knowledge (Graff 2010; Haskell 2001) sought to enhance students’ environmental problem-solving through interdisciplinary methods. The ability to transfer and apply knowledge learned in one context to other situations is one attribute frequently linked to student success; it is one of the important “habits of mind” recognized for effective recruitment and retention of students, especially those in the early stages of their academic careers (Fletcher et al. 2015).

Preliminary Exercise: Carbon Footprint. In preparation for the course, students complete an exercise in which they calculate the carbon footprint associated with their travel. These calculations (performed via the online carbon calculator located at http://www.terrapass.com/carbon-footprint-calculator/) are used to generate estimates of the number of trees that could be planted to offset students’ carbon footprints. During the course, students can elect to actually plant their estimated number of rainforest trees (see Figure 2) as well as visit a Costa Rican coffee cooperative that produces and sells coffee labeled as “carbon-neutral.” Thus these experiences provide a context for a discussion about carbon offsets, local government plans involving payment-for-environmental services, and international agreements aimed at countering climate change by bolstering conservation efforts (e.g., reducing emissions from deforestation and forest degradation, or REDD). This exercise also provides an opportunity for discussing the nature of service learning, another well-established high-impact practice (Gaventa 1993; Sigmon 1995). In some cases, students have come to realize that planting trees, even ones appropriate (native) to the area, may not be serving the community well because the course timing does not align with local conditions (i.e., does not occur during rainy/planting season), which can lead to fruitful discussions of the nature of service and service learning as well as more general issues associated with conducting participatory research in local communities.

Research: Individual Projects. Students must design, implement, and complete individual research projects during their time abroad. This requires them to delve into the literature, so that they acquire disciplinary knowledge and context for their inquiry before departure. They also gain practical skills in methodology and implementation when they undergo the arduous task of conducting research in a tropical environment. Projects have ranged from assessment of the antimicrobial properties of plants and insects to explorations of biodiversity patterns and animal behavior in the forests and rivers in and around Mastatal (see Figure 3). These projects foster creativity, the application of qualitative and quantitative analysis skills, and a nontrivial amount of resiliency. Setbacks associated with time management, stochastic events such as torrential downpours/flash floods and animal disruptions (e.g., ubiquitous spiders and snakes) of sampling efforts, and overly optimistic planning of the scope and extent of projects are common challenges experienced by students. Close mentoring by faculty can help guard against more di-
sastrous outcomes, but many of these challenges help students build confidence and self-efficacy. Students present their results to the host community and the campus community upon their return via oral or poster presentations, as well as publish them in an edited proceedings volume (e.g., Banks et al. 2016). These activities reinforce their sense of ownership and scholarly identity, which can lead to gains in self-efficacy and a deeper understanding of the entire research process.

Research: Guided/Collaborative Projects. In addition to individual projects, students also work in group projects guided by close mentoring. The combination of guided and individual research projects in the same course of study pays dividends by enabling students to move/transfer skills/ownership between group and individual projects. One advantage of guided projects is that they can continue over the course of several years, with multiple cohorts of students participating. One such project conducted in Mastatal was a multiyear research program that entailed comparing arthropod biological diversity among farmland and rainforest habitats, which eventually led to a publication coauthored by several of the undergraduates (Banks et al. 2007). This led to an invitation to contribute the data collected with students to an international study of biological diversity across different landscapes, furthering the reach and impact of student research (Hudson et al. 2014). These kinds of endeavors can serve as examples to inspire future students, as they see how they might successfully contribute to scientific knowledge on a global scale.

Visits to local venues upon returning to the United States reinforce many of the lessons learned during the international experience. For instance, an afternoon at a local U.S. organ-fair trade chocolate producer provides an opportunity for students to connect what they learned (via a class visit and/or individual research projects) on a cacao plantation in Mastatal. Likewise, visits to local coffee roasters in the United States after touring coffee plantations involved in sustainable coffee production in the Tarrazú region of Costa Rica affords students a close-up view of the supply chain as a continuum, making for a more meaningful understanding of myriad social and environmental issues. These connections enable students to put their scientific inquiry in a global perspective.

Experiences in the Social Sciences: Ethnographic Field Research in Spanish Rural Communities

The Spain Summer Program at CSUMB (CSUMB Spain) shares three of the categories identified by the American Association of Colleges and Universities as high-impact practices (Kuh 2008). It fosters undergraduate research involving students in empirical observation as well as rigor in practices of qualitative research, and promotes the exploration of early and active research design, data collection and analysis, and dissemination of findings. It also helps students explore cultures and visions that are often radically different from their own views and understandings. Because of the nature of the program, the interaction and integration in the field is conducted in the midst of a well-structured opportunity to provide service to the communities where the research training experience is conducted. Although a three-layered experience (undergraduate research combined with global and service learning) or a stacked experience is complex and ambitious, the program has gradually developed the necessary structure and resources to offer students such exposure (described below).

The program takes place in the watershed of the Porma River, a geographic region of transition where the Picos de Europa meet the higher plains of central Spain. The villages are situated around the town of Boñar, where the field station is located. The once densely populated mining and agricultural communities surrounding Boñar started experiencing a chronic depopulation in the 1960s. Today, localities with previous populations of 200 to 300 are now sparsely inhabited.

Academic Rigor: Facilitating Sheltered, Directed Research. To achieve approval of the program from the division, college, and university-wide curriculum committees, the lead faculty members worked in collaboration with the Institute of Service Learning and the Center for Teaching and Learning in defining the set of outcomes, criteria, and standards for the program; in equipping students with instructional and support methods; and in identifying outcomes that should serve to measure learning outcomes (see Table 1).

The program drew from an existing set of language, service learning, and methodology courses that prepared students for such intensive experience. This type of preparation has
been deemed critical in accomplishing goals in the intensive, 30-day experience. One challenge of the program was the creation of conditions where students could enter the field in a well-structured and sheltered immersion or “directed field experience” (Palerm and Olvera 2013). Although undergraduates cannot usually be expected to conduct research with the level of autonomy of, for example, graduate students, undergraduates—with guidance from the field director—are able to apply appropriate research methodologies to a central research question.

During the first iteration of the program in 2012, it became clear that the time allotted for the course precluded students from fully developing their own research question and approaches. In subsequent years, the program director created a student handbook that provided a menu-driven selection of specific research questions and protocols to follow. During the first week, students map the communities assigned, identifying main physical elements, resources, and spaces. During the second and third weeks, students explore other methods and techniques of methods of data collection and analysis, usually practicing first among themselves and then applying the technique or method in the community. (see Figure 4) The last week of the program is devoted to coding, conducting preliminary analyses of the information, and preparing preliminary reports to members of the communities. Upon return to the United States, students present their findings to other students and faculty members on campus. Students are expected to submit their reports to a student online journal for peer review and publication (Gutiérrez and Figueroa 2016).

Through such a sheltered and structured context, program participants have carried out different activities in collabora-
tion with the local chapter of the Red Cross. Around Boñar, Red Cross activities center on assisting older adults and providing instruction on public health and safety for children. Three days a week, students typically spend two or three hours per day collaborating with Red Cross volunteers and professionals. Such teamwork enables students to become acquainted with and earn the trust of families and individuals in the community, providing a quality and level of interaction that would have been difficult to attain in different circumstances. Because there is substantial overlap between the ethical considerations of ethnographic field research and service learning, these two activities can easily be structured together in a relatively short field-based experience.

Assessment
To assess the effectiveness of these practices, the programs adopt different strategies that are defined by a clear identification of the programmatic, pedagogical, curricular, and training goals of the experience. From the program perspective, each of the experiences aspires to be sustainable and fiscally responsible. For both programs, for example, the program leaders determine a baseline budget that gives priority to the safety of the group and factors in the basic needs and logistics necessary to run the program. Similarly, the programs are scrutinized each year for compliance with risk management parameters and other university policies. Part of the programmatic outcomes include the maintenance and strengthening of local ties and objectives that are defined and revised with local constituencies. For example, the Red Cross staff and the program director for the Spain program hold planning meetings each year to define the objectives for the summer session, thereby ensuring that the Red Cross’s perspective is included. For the Costa Rica course, the program director similarly consults with faculty and in-country partners about objectives/goals during the year leading up to the program.

Pedagogically, the parameters in the Spain program are mostly defined in terms of the level of student participation in the definition of their own research agendas and the need for a clear frame or structure of activities that enable the student to reach programmatic objectives in a very short period of time. In curricular terms, the specific learning outcomes identified for the course define the objectives. The course has both disciplinary outcomes as well as outcomes specific to service learning. Disciplinary outcomes are related to the students learning methods and techniques of data collection and analysis; they systematically accumulate empirical evidence and materials that they begin to analyze during the last week of the experience. A more reflexive approach is required for those students who choose to transform their summer experience into senior capstone (graduating) projects.

The participation record of the social science program is encouraging despite the modest number of participants and the relatively small enrollment at the CSU Monterey Bay campus. Since it was first created in 2012, the Spain summer program has provided direct instruction to 49 students and indirect benefits to 256 students (via the research methods course used as training/preparation). The graduation rate of comparable institutions in size and degree of selectiveness is 77 percent, whereas the graduation rate of students participating in the Spain program is an impressive 98 percent.

The Costa Rica Field Studies course has served 91 students since its inception at UW Tacoma a dozen years ago (including 25 first- or second-year students participating in a shorter course and students enrolled in the 2016 course through CSU Monterey Bay). Although student outcomes were not quantified for the program until the most recent course, students were asked to provide reflections upon completion of the course. Anecdotal positives (including several students who changed majors to environmental science as a result of the course or who subsequently pursued graduate studies in...
the life sciences) were common. One female lower-division participant—one of several who became involved in student leadership on campus the following year—held a typical view:

■ “This trip was one of the most memorable, amazing adventures I have ever been on. Living in a sustainable environment has been a mind changing experience.”

A student from the 2016 CSU course enthused:

■ “I believe this entire experience in its entirety was valuable and rewarding. Everything that was done, from the academic material to the exposure to the real culture of Costa Rica was put together harmoniously and gave me an entire experience that has changed my perspective on research and the world.”

For the 2016 course, 100 percent of respondents to a post-course survey stated that they felt they had gained a great deal of knowledge and skills in both statistical approaches to research as well as designing and carrying out research projects. In general, reflections for both lower- and upper-division students illustrate an enhanced awareness of both personal and academic growth; this meta-cognitive perspective is encouraged during regular class check-in discussions throughout the course. As the course has transitioned to CSU Monterey Bay and serves students across the California State University system, more holistic comprehensive assessment strategies—including an ethnographic study of village residents focused on how this course and others have affected the village over time—are underway.

Creating a Culture of Research: Coordinating Undergraduate Research at the University Level

The bedrock of a good undergraduate research program is a strong campus research culture. Creating a culture of undergraduate research at the university level naturally presents serious challenges as well as opportunities. It requires, for example, the creation of structures that include assessment practices and the development of sound and sustainable mechanisms to finance the activities. The payoff of creating such a culture is that, as such structures are created and consolidated, more students will be compelled to engage in such activities. For faculty members, the expectation that they will be able to include undergraduate students in their research endeavors would ideally be accompanied by administrative structures and incentives that would reaffirm the campus commitment to such activities—and necessarily include clear, supportive language in tenure and promotion criteria. Having centralized resources devoted to undergraduate research is also critical. For example, faculty members who hesitate to ask a group of undergraduate students to code materials, sort collections, or process/analyze data in a given project may be more amenable to training those students if they know that the students will be supported and recognized by a campus-wide office of undergraduate research.

Established in 2009, the CSUMB Undergraduate Research Opportunities Center (UROC, https://csumb.edu/uroc) brought together faculty members and administrators who recognized the potential of a transformative program for undergraduates that would also engage faculty inside and outside of the classroom. Understanding the importance of creating a culture of research across programs and majors, they also recognized the place of that culture in feeding expectations and heightening the level and quality of participation. UROC serves CSUMB students across academic units through summer and academic-year placements in mentored research experiences on campus or at regional, national, and international partner institutions. UROC also offers seminars and workshops that address issues critical to student success, such as finding research opportunities, developing writing skills, developing a scholarly identity, networking, increasing cultural capital, navigating the “hidden curriculum” of academia, and preparing for and applying to graduate programs. Undergraduate research is often heralded as one of the most powerful high-impact practices because it can easily engage faculty members and students from across disciplines and also generate palpable benefits (Malachowski et al. 2015). Furthermore, encouraging undergraduate participation in research naturally raises the profile of research on campus, which pays tremendous dividends in the classroom, as faculty can draw on their own or shared experiences with research to illustrate key concepts in the curriculum (Prince et al. 2007). This cycle is augmented when international perspectives are layered on these research experiences; this stacking of high-impact practices heightens both experiences, providing inspiration and context for both formal (curricular) and informal learning. Each campus should build on its own strengths and trajectories, but a larger conversation involving key players across programs and areas will be required. In the cases described in this article, a campus-wide office of undergraduate research propels undergraduate research, building on a solidly established culture of service learning and banking on multiple programs and faculty-led research programs that have involved undergraduate research since the university’s inception in 1994. Upcoming challenges include the systematic generation of funding opportunities for existing and emerging programs and a more deliberate inclusion of curricular activities that foster, structure, and reward undergraduate research as an integral part of the faculty workload. Fundamentally, the common denominator of all of these practices is that they take students away from situations in which they are invisible and anonymous, placing them instead in circumstances where direct and meaningful interactions with peers, instructors, and matters of substance are the norm (Kuh et al. 2007). A remaining challenge is how a university
The Future of International Undergraduate Research

Although the importance of research experiences for undergraduate students is a well-established principle for most universities in the United States (Taraban and Blanton 2008), infusing these experiences with a global perspective has a high potential to yield extraordinary outcomes for academic communities. The experiences described here support what other authors have amply documented: an international experience adds—stacks up—high-quality outcomes in professionalization and readiness for graduate school for undergraduate participants. Furthermore, the scholarly vibrancy of such experiences bolsters standards of attainment that affect all other students pursuing similar paths. Finally, research experiences in international social science (or natural science integrated in a meaningful way with social science issues, as Viseu [2015] notes) may be a way to increase interest and participation of students outside of more traditional lab/field offerings in the natural sciences.

There are also important ethical implications in the creation of interactions with local communities and institutions abroad. Faculty leaders of these international instructional programs described here, resulting in the gradual embedding of high-impact practices into the fabric of the academic community. Overall, institutional support for concerted, cooperative efforts can multiply via the creation of campus cultures of HIPs such as undergraduate research, service learning, global citizenship, internships, and capstone experiences.

In closing, synergies between the high-impact practices of global learning and undergraduate research may be driven by some clear commonalities in the two as students experience them. In particular, as McKeown (2009) points out, international experiences require students to be willing to adjust their attitudes and biases as they encounter new experiences and evidence. This is strikingly similar to what we ask of undergraduates conducting research; in inquiry-based exercises such as ecological field research, success often requires students to deal with uncertainty. In the social sciences, students are similarly exposed to revisiting their cultural parameters and assumptions—a fundamental prerequisite for social inquiry. In both disciplinary areas, stacking these high-impact practices helps link the curriculum and experiential learning by asking students to compare and update what they have learned in the classroom with newly obtained knowledge from the field. As a result, students engaging in multiple high-impact practices can experience synergistic outcomes, as each endeavor informs and facilitates success in the other. This deliberate, intentional stacking of undergraduate research and global learning can be a model for effective combinations of other high-impact practices.


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**doi:10.18833/curq/37/3/8**
Partnering with Students in Iceland and Continental Europe to Develop a New Undergraduate Microbiology Research Journal

Abstract

*Fine Focus*—an interdisciplinary, product-based course—has involved 12 to 24 undergraduates each semester since 2013. This course developed and manages the first international digital and print journal for undergraduate microbiology research, with the American Society for Microbiology (ASM) as a partner. The course’s student review team makes decisions that direct the future of the journal, including the double-blind peer-review system; the marketing/graphics team determines the best targeting of *Fine Focus* to a global audience; and undergraduates in Iceland recently participated to pilot this learning model in a different educational climate, enhancing the home university’s international profile at the same time. The author discusses how these students gained a comprehensive understanding of working with others across disciplines in a professional atmosphere, creating a respected and tangible product that contributes to the undergraduate microbiology research community, and publishing their microbiology research. This faculty-led, student-driven “immersive learning” model allows the students to be the authors of, and authorities on, their own education.

**Keywords:** course-based research, immersive learning, interdisciplinary, microbiology, scholarly publishing

Overview of Teaching Model:
The “What, How, and Why”

Development of creative student-centered research into existing biology curricula is a major theme of the recent AAAS Call to Action (Brewer and Smith 2011), as is “community-based participatory research.” Ball State University can take advantage of many of these rapidly evolving objectives in undergraduate science education largely through its Biotechnology Certificate Program, an active chapter of Sigma Xi, and the first ASM chapter in Indiana (McKillip 2010). Building on these opportunities, editorial board experiences with disciplinary journals, and 15 years of mentoring microbiology undergraduates, the author—a Ball State faculty member—decided to develop a product-based course to pilot that would fit the university’s definition of “immersive learning.” The end product would be the first undergraduate journal for microbiology research published in both print and digital versions. However, this course would possess most of the defined characteristics of immersive learning (Pagano 2013):

- Carry academic credit
- Engage participants in an active learning process that is student-driven but guided by a faculty mentor
- Produce a tangible outcome or product, such as a business plan, policy recommendation, book, play, or DVD
- Involve a team of students, often working on a project that is interdisciplinary in nature
- Include a community partner(s) and create an impact on the larger community as well as on the student participants
- Focus on student learning outcomes
- Help students define a career path or connect to a profession or industry

In short, *Fine Focus* is a faculty-led, student-driven, product-oriented course offered each semester under a variety of departmental credits, including honors, practicum, special topics, and related hours.

For some time, it has been clear that undergraduates need to be trained on the aspects of doing science that follow the completion of their laboratory bench work, fieldwork, and data analyses. Such experiences include acquisition of a working knowledge on scientific writing, editing, peer review, graphic design, and marketing, as they relate to dissemination of microbiological research data through an academic journal with international scope. Because many undergraduate science curricula do not thoroughly teach these skills, students are not fully equipped to become faculty members, industry scientists, peer reviewers, or editors. Undergraduate students also need to graduate with established, permanent, professional contacts in varied subdisciplines of microbiology worldwide. Addressing these needs through a product-based course would entail multifaceted aspects of both teaching and research.

For the development of the course at the home institution and implementation in Iceland, the dynamic was designed carefully. The students are empowered to develop ownership on the products of their labor—to share in the vision. This professional and personal investment of time and interest stems from direct engagement of the students at all levels of
the journal’s development and dissemination. Three teams of students are typically assigned each semester. First, a review team composed of four to five students in the life sciences (typically pre-med, microbiology, or zoology majors) are taught to coordinate a two-tiered review process. These students secure and manage incoming manuscript submissions to two or more outside reviewers (faculty or industry contacts at other institutions who serve on the Fine Focus editorial board) as well as participate in a simultaneous in-house review of the submissions. Second, a graphics team composed of four to five students (typically communications, graphics, and/or computer science majors) spearhead the effort of preparing proofs for corresponding authors and assembling the final papers into bound print journals for dissemination to those who subscribe. These students also manage the electronic version of Fine Focus, including the ancillary aspects of the associated website. Third, a marketing team of four to five students explores avenues for perpetuating the journal beyond the internal grant-supported funding period. For example, this team from marketing and management secures sponsorship from vendors and arranges advertising. This role involves travel to regional and national scientific conferences, such as the American Society for Microbiology (ASM) and the National Conference on Undergraduate Research (NCUR), to stimulate interest and solicit manuscript submissions.

By the time of the Iceland experience, Fine Focus was in its third year and thus had evolved to the point where it could be successfully managed by a slightly smaller group of students, but in Iceland these individuals still represented disciplines and worked in teams. Class days (approximately four hours each week of contact time) were spent clarifying weekly action items and objectives, providing instruction on scientific writing (via Lindsay 2011), hosting guest speakers in specialty areas, and presenting team progress reports.

Implementation (the “Where”) Founded in 1987, the University of Akureyri (UnAk) is a vibrant university on the north coast of Iceland with small but steadily increasing enrollments in biotechnology-related courses, including microbiology. Faculty at UnAk actively engage with undergraduate students in a variety of research projects. Some of these faculty members had served as co-authors on several grant proposals of the author, providing a foundation for future collaboration. In October 2013 the author traveled to UnAk as a seminar presenter and guest lecturer for a biotechnology/microbiology course, where he met with faculty and undergraduate students in this discipline. These meetings led to the conclusion that a course such as Fine Focus would provide a unique professional development opportunity for an array of students (they ultimately came from the Czech Republic, Finland, Iceland, and the United States). Students were recruited by the author, an Icelandic colleague, and the UnAk international students’ office. By enrolling this diverse group of students (see Figure 1), it was hoped that the profile of Fine Focus could be raised in Iceland and the rest of Europe and result in increased submission of undergraduate research manuscripts. However, a number of other course objectives were added for these students, such as the following:

- Initiating a crowdfunding site for Fine Focus (http://www.firstgiving.com/fundraiser/johnl-mckillip/FineFocus/)
- Applying for an ISSN and working to place Fine Focus in searchable scientific databases, including EBSCOhost.
- Managing incoming manuscripts
- Increasing the size of the editorial board (to approximately 75 individuals)
- Cultivating closer partnerships with ASM, NIH, Sigma Xi, and/or the Council on Undergraduate Research (CUR)

Regarding assessment, students involved in Fine Focus come away with a working knowledge of three fundamental concepts:

- How to organize people and resources essential for academic and fiscal success of a start-up research journal,
- How to effectively critique scientific writing and communicate assessments to corresponding authors—a vital skill in many disciplines, and
- How to blend creativity (in overall design and marketing of the journal) with the objective guidelines that govern proper scientific experimental design and strict manuscript format.

Figure 1. Fine Focus Biotechnology Students at the University of Akureyri in Iceland Complete an Internal Peer Review for Comparison to Comments by Outside Experts from the Double-blind Review Process
Journals are kept by each student as a daily log of responsibilities, objectives, and outcomes. Weekly roundtable sessions with the students identify problems encountered and questions, discuss possible solutions, and formulate decisions that are voted on by the students. This approach reinforces the idea that the journal’s success is based on student input. In addition, weekly meetings with each student provide a venue for discussing matters impractical in a group setting. Student grades are compiled partially by students grading the others, including themselves (which occurs at midterm and at the end of the semester). These grades are submitted to the faculty member without any students seeing each other’s evaluations. The faculty member assimilates these scores and compares them generally with his overall subjective rank on each student’s performance. The student journals and self-assessments determine an overall final course grade for each student.

In addition, an assessment rubric designed for immersive learning courses at Ball State (https://cms.bsu.edu//media/www/departmentalcontent/immersivelearning/pdfs/provost_grant_assessment_tool_example.pdf?la=en) may assist in gathering quantitative data on the overall impact of Fine Focus. Its metrics might be applied to the degree of collaboration among the team(s) of students, involvement of community partners, quality of the product generated, and completion of key course objectives. This rubric, as well as a consumer survey completed by fall 2016 students, will allow measuring of defined ways that the digital and print journal can offer improved content, quality, and aesthetics for prospective authors, editorial board members, and other collaborators.

The semester in Iceland managing Fine Focus was likely the most productive and positive term to date in terms of accomplishments, some of them unexpected opportunities upon which the students could capitalize. Collaboration between students at the home and host institutions came about naturally. The digital proofs were copyedited multiple times, and a great deal of correspondence ensued between the Icelandic review team and the graphics team and printer in Indiana. This exchange allowed the Icelandic students to hone their skills in English.

One additional highlight was the chance for Finnish exchange student Saara-Maria Helena Kallio (an international marketing major) to present at the British Conference of Undergraduate Research (BCUR) in March 2016 in Manchester, UK (see Figure 2). This professional development opportunity was the perfect capstone experience for Kallio. She was able to network and promote Fine Focus to a new audience by distributing logo-emblazoned polo shirts, print copies of the latest issue, and other promotional information. This experience proved key to Kallio’s obtaining a business internship in Germany during summer 2016. Kallio’s many emails during

and following BCUR revealed that this experience was one of the most professionally meaningful and rewarding ones for her and certainly one that positively affected Fine Focus. The current group of Fine Focus students have once again brought Kallio into a collaboration by inviting her to be a founding member of the executive committee, which will plan for long-term success of Fine Focus as a journal and as a course. The first executive committee meeting is tentatively planned for autumn 2017 and will involve four to five individuals in marketing, graphics, and microbiology representing a diversity of content knowledge, geographical background, and journal/technical writing experiences.

Challenges and Adaptation

English is a principal language spoken in Iceland and is the universal language of science. Even though no language proficiency requirements are in effect for this location, the author worked to become fluent in Icelandic to facilitate communication between students and colleagues. Professional development opportunities such as Fine Focus are the universal conduit for success in scientific disciplines. Thus, implementation of this course at UnAk differed in only a few fundamental ways from how it is done at the home institution. First, the culture of Iceland is deeply rooted in its Scandinavian heritage and history, regardless of an individual’s career path or level of education. As such, the approach to managing this course involved a much more active dialogue and exchange of personal ideologies than usually used by the faculty member. Significant time was spent getting to know each student and becoming acquainted with their personal and professional backgrounds as well as their career visions, so that the cultural divide could be bridged, and free and open communication could be fostered.

Second, the smaller class size (eight students) at UnAk was a stark contrast to most of the content courses at the home institution. However, this more readily cultivated positive, small-group dynamics and the team approach implemented for Fine Focus. The smaller size also facilitated continually evolving marketing/promotion activities and manuscript management.
Undergraduate Research Abroad: Different Program Designs Serve Different Needs

Abstract
Research abroad programs for undergraduate students in science, technology, engineering, and mathematics (STEM) provide high-impact learning experiences, but little has been done to assess the scientific and cultural gains of participants. This article compares the learning gains of 10 students who participated as a group conducting research in the Czech Republic with the learning gains of 10 solo students who participated in research abroad and 117 students who participated in research on the University of Arizona (UA) campus. Students' background and experience as well as program structure played a role in how students benefited. Although increased confidence was reported by students in all three programs, the solo model of undergraduate research contributed to the greatest growth in non-field-specific areas such as communication, networking, and patience. Students in the group international research experience and in the domestic research experience reported the greatest disciplinary gains such as learning laboratory techniques. Findings indicate that both group and solo international undergraduate research programs should be available so that students can select an experience that meets their needs.

Keywords: international educational exchange, STEM, student outcomes, study abroad, undergraduate research

Introduction
Many of the problems facing humankind require solutions by individuals who can apply their scientific skills cross-culturally. Agencies such as the National Science Foundation (NSF) and the National Institutes of Health (NIH) have established offices to ensure that U.S. researchers, including scientists-in-training, are globally engaged. Research abroad experiences help undergraduate students understand the global nature of science and equip them with an international perspective.

Although STEM students participate in undergraduate research in greater numbers than students in other majors, they represent just 24 percent of all U.S. study abroad students (Institute of International Education 2016). One means of enticing STEM students to an international experience is to engage them in summer research abroad. There are a growing number of research abroad programs but little in the literature to provide guidance on maximizing students' scientific and cultural learning. Research abroad shares features with study abroad. Students live in a different culture, establish new relationships, and are exposed to different worldviews. Lou and associates (2012), in a review of the study abroad literature, recommend the following practices to maximize learning in study abroad programs:

- Provide students with clear goals about what they should gain from study abroad,
- Identify clear learning outcomes and design programs to achieve these,
- Embrace the principle of “intervention” with students studying abroad but understand that there is no best or single way to intervene, and
- Develop an assessment that uses both formative and summative tools.

At UA, we sought to understand more about students’ scientific and cultural gains from participants in research abroad programs with different structures compared to students who had a domestic research experience. The Biomedical Research Abroad: Vistas Open (BRAVO!) Program, begun in 1992, supported 255 UA students over 24 years. Although BRAVO! participants consistently reported that their experience was “difficult but transformational,” it is important to look beyond students’ assertions to assess impact.

A BRAVO! student has a total-immersion experience, in which an unaccompanied student is the only American working in the research group. We wondered how students’ experience would be different in a group with other American students and an on-site director who served as a cultural liaison. Thus we offered a group-based research abroad program, Prozkoumat! (Czech for “explore”), in parallel with BRAVO!, during summer 2015. Concurrently a domestic undergraduate research program—the Undergraduate Biology Research Program (UBRP)—was offered at UA. We posed the following questions:

- What were the differences in personal characteristics and research experiences between Prozkoumat! and BRAVO! students at the time of application?
- What were the primary motivators for students to participate in these programs?
- What personal gains did students report?
Last, the interdisciplinary nature of *Fine Focus* necessitated students with backgrounds/interests in marketing/advertising, graphic arts, and microbiology. Such broad student backgrounds required a proactive recruiting effort initiated well before the author's arrival at UnAk, facilitated by an UnAk colleague who advertised the course, objectives, and broad goals. The resulting internationally diverse group of motivated students was a pleasant surprise, considering the fact that they had enrolled with little knowledge of the big picture of the course, the teaching model of the course, and the journal.

Funding was, and is, an ongoing challenge. The principal costs of perpetuating *Fine Focus* are printing costs and student travel. Since *Fine Focus* does not have page charges, submission fees, or subscription revenue, the operating costs must originate from grant support, funding from private foundations, and donations. Relatively few federal grant opportunities are geared toward this product-based learning model, and even fewer private foundations offer funding possibilities for science education or scholarly engagement beyond K–12. The FirstGiving site should offer some assistance in this regard, but continued growth will require creative and nontraditional outreach to obtain sponsorship by additional community partners and professional societies.

**Broad Impact and Future Growth (Evolution)**

*Fine Focus* offers transfer and adaptation possibilities for other institutions. Because the need for greater information literacy and technical writing skills is universal, the target student pool is ubiquitous. Although implementation of such a course would depend on the infrastructure of a particular college or university, establishing a collaborative network of professionals is certainly necessary. Many activities of the *Fine Focus* students may involve expertise well outside of a faculty member's comfort zone. However, with departmental/college/provost funding, outside speakers can be engaged, offering roundtables and forum sessions vital for student connections to professionals outside of the home institution. The *Fine Focus* faculty member and students have hosted and traveled to visit editors-in-chief as well as experts on marketing, printing, assessment, and science education/service learning. Reflecting student leadership and the tendency of these experts to be much more responsive to student rather than faculty inquiries, the students extend the invitations, handle the logistics of visits, and manage the dialogue during guest speaker days. This approach works because all participants share the broad vision of the student-generated, faculty-led model.

Other aspects of *Fine Focus* offer resources to the undergraduate research community. First, the journal's instructions to authors is a succinct and clear set of guidelines for prospective undergraduate authors anywhere, regardless of the particular journal target for their manuscript. In addition, posted on the *Fine Focus* website (http://www.finefocus.org), are two tutorial videos on preparation and presentation of figures, tables, and legends for professional publications. Second, the marketing teams have developed a comprehensive style guide encompassing color, paper, formatting, logo, and printing criteria for print and digital journal production. Third, a new custom template is in development for Overleaf™ that should facilitate and streamline manuscript submission formatting in the future.

The Iceland semester for *Fine Focus* led to a larger pool of potential reviewers, editorial board members, and international manuscript submissions. Because of this success, an executive committee can be established that will oversee strategic planning decisions. Like the editorial board, this committee will be international in composition and diverse in content knowledge. This latest development builds on the *Fine Focus* experience as an immersive learning course benefiting students at home and host institutions and as an open-access undergraduate microbiology research journal. Through close association with professional societies such as ASM and CUR, a constant flow is ensured of fresh ideas, energy, and original manuscripts that reflect the work of undergraduates in the international community of microbiology and science education.

**References**


**John McKillip**

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*John McKillip is associate professor in the Department of Biology at Ball State University and serves as a CUR Councilor for the Biology Division. He earned a PhD in microbiology from Washington State University in 1997 and completed a postdoc at Mississippi State University in 1999. His research program centers on molecular food safety/bacterial detection using DNA and RNA-based methods. Since 2009, McKillip has served on the editorial boards for the Journal of Food Protection and the Journal of Dairy Science, most recently as a section editor and senior editor for JDS.*

**doi: 10.18833/curq/37/3/13**
What changes in students’ cultural awareness occurred?

What can be inferred from the gains experienced by students when they traveled alone (BRAVO!) versus when they traveled in a group (Prozkoumat!)?

How did students’ scientific gains compare to those reported by students doing research in the United States (UBRP)?

Background

BRAVO! sends research-experienced UA undergraduates abroad for 10 weeks. The goals are the following:

- To introduce students to the international scientific community and to promote international understanding, and

- To advance collaborative projects involving UA biomedical and behavioral researchers and foreign scientists by having students participate in research abroad that augments their domestic research (Bender 2004).

BRAVO! students have six months of research experience before applying. They prepare and defend a proposal for the work to be done abroad as part of their application. Students also submit a personal statement, transcripts, summaries of previous research experience, and letters from their U.S. and foreign mentors. The selection committee, composed of STEM faculty, interviews each student and assesses the student’s scientific and emotional maturity. Since the program’s inception, BRAVO! students have worked in 37 countries. During summer 2015, BRAVO! students were placed in Argentina, Australia, England, Germany, Mexico, Norway (two students at different institutions), Scotland, and Sweden (two students at different institutions).

Prozkoumat! was first offered during summer 2015 as a group international research experience accessible to students who did not have previous research experience. Prozkoumat! goals are the following:

- To introduce ethnic minority and economically disadvantaged students to the international scientific community and to promote international understanding, and

- To contribute to research and the fund of knowledge that will reduce health disparities worldwide.

The Institute of Parasitology at the Czech Academy of Sciences in Ceske Budejovice, Czech Republic, was selected as the Prozkoumat! site because it was a BRAVO! site and because the institute allowed a placement of each student in a different research group. The institute shares a campus with the University of South Bohemia (USB), and the students were housed in a USB dormitory.

UBRP is a large undergraduate research program in the life sciences established in 1988. The program provides paid research experience to UA undergraduates in UA scientists’ research groups and includes professional development, seminars, social activities, and an annual poster conference (see Table 1). No academic credit was given for the programs. BRAVO! and Prozkoumat! students received full financial support for their participation (travel, room, board, stipend, and research supplies), and UBRP students were paid hourly wages. Many, but not all, BRAVO! and Prozkoumat! students participated in UBRP.

Unlike BRAVO! students, Prozkoumat! students did not work with foreign collaborators of UA mentors. Students in the BRAVO! group had more research experience than those in the Prozkoumat! group (two Prozkoumat! students had no re-
search experience). The average GPA of the BRAVO! students was higher, and the range was narrower, than in the other groups (see Table 2). One BRAVO! student and two of the Prozkoumat! students had not traveled outside the United States prior to the experience.

**Preparation for the International Experience.** The research experience of BRAVO! students at UA and the proposal they wrote as part of the application process served as their scientific preparation. Prozkoumat! students took two courses during the spring semester—an introduction to parasitology and a cultural orientation to the Czech Republic.

BRAVO! and Prozkoumat! students met for a two-evening orientation in March 2015 to discuss safety and acculturation.

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**Table 1. Differences among BRAVO!, Prozkoumat!, and UBRP Programs**

<table>
<thead>
<tr>
<th>Programs</th>
<th>BRAVO!</th>
<th>Prozkoumat!</th>
<th>UBRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Abroad Programs</td>
<td>Individualized model: students travel and live in a group; each is assigned to a different research group in the same institute</td>
<td>Group model: students travel and live in a group; each is assigned to a different research group in the same institute</td>
<td>Students work in different research groups on the UA campus and make their own living arrangements</td>
</tr>
<tr>
<td>Domestic Research Program</td>
<td>Six months of research experience required</td>
<td>No previous research experience required</td>
<td>No previous research experience required</td>
</tr>
<tr>
<td>Proposal for project is part of the application</td>
<td>Proposal is written after acceptance to program in pre-departure course</td>
<td>No proposal is required</td>
<td></td>
</tr>
<tr>
<td>Students work with a foreign collaborator of their UA mentor</td>
<td>Students are assigned to one of 10 research groups at the Institute of Parasitology</td>
<td>Students match themselves to UA scientists doing work that interests them</td>
<td></td>
</tr>
<tr>
<td>Two-evening, pre-departure orientation</td>
<td>Two-evening, pre-departure orientation and two required courses: Parasitology and Intro to Czech Republic</td>
<td>One-day program orientation</td>
<td></td>
</tr>
<tr>
<td>Minimum of 10 weeks of full-time research abroad</td>
<td>Minimum of 10 weeks of full-time research abroad</td>
<td>Minimum of 12 weeks full-time summer involvement</td>
<td></td>
</tr>
<tr>
<td>No structured professional development or cultural program while abroad</td>
<td>Research ethics training, seminars, professional development, and cultural activities while abroad</td>
<td>Weekly professional development activities, research ethics training, field trips, and seminars</td>
<td></td>
</tr>
</tbody>
</table>

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**Table 2. Characteristics of BRAVO!, Prozkoumat!, and UBRP Students**

<table>
<thead>
<tr>
<th>Programs</th>
<th>BRAVO!</th>
<th>Prozkoumat!</th>
<th>UBRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>3 Male</td>
<td>4 Male</td>
<td>56 Male</td>
</tr>
<tr>
<td></td>
<td>7 Female</td>
<td>6 Female</td>
<td>61 Female</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>8 Caucasian</td>
<td>1 Caucasian</td>
<td>64 Caucasian</td>
</tr>
<tr>
<td></td>
<td>1 Asian</td>
<td>30 Asian</td>
<td>1 Hispanic</td>
</tr>
<tr>
<td></td>
<td>8 Hispanic</td>
<td>13 Hispanic</td>
<td>1 Native American</td>
</tr>
<tr>
<td></td>
<td>1 Native American</td>
<td>7 Native American</td>
<td>2 African American</td>
</tr>
<tr>
<td>Income status</td>
<td>1 Pell Grant Eligible (10%)</td>
<td>4 Pell Grant Eligible (40%)</td>
<td>38 Pell Grant Eligible (32%)</td>
</tr>
<tr>
<td>Year</td>
<td>3 Rising Juniors</td>
<td>7 Rising Seniors</td>
<td>13 Rising Sophomores</td>
</tr>
<tr>
<td></td>
<td>7 Rising Seniors</td>
<td>9 Rising Seniors</td>
<td>33 Rising Juniors</td>
</tr>
<tr>
<td>Majors</td>
<td>3 Neuroscience</td>
<td>2 Neuroscience</td>
<td>28 Neuroscience</td>
</tr>
<tr>
<td></td>
<td>1 Physiology</td>
<td>16 Physiology</td>
<td>15 Biochemistry</td>
</tr>
<tr>
<td></td>
<td>1 Biomedical Engineering</td>
<td>1 Biomedical Engineering</td>
<td>15 Biomedical Engineering</td>
</tr>
<tr>
<td></td>
<td>2 Molec. and Cell Biol.</td>
<td>3 Molec. and Cell Biol.</td>
<td>11 Molec. and Cell Biol.</td>
</tr>
<tr>
<td></td>
<td>1 Biology</td>
<td>6 Biology</td>
<td>1 Microbiology</td>
</tr>
<tr>
<td></td>
<td>1 Microbiology</td>
<td>4 Microbiology</td>
<td>3 Chemistry</td>
</tr>
<tr>
<td></td>
<td>1 Speech and Hearing</td>
<td>3 Speech and Hearing</td>
<td>2 Anthropology</td>
</tr>
<tr>
<td></td>
<td>2 No major selected</td>
<td>2 No major selected</td>
<td>2 Nutritional Science</td>
</tr>
<tr>
<td></td>
<td>1 Chemical Engineering</td>
<td>1 Chemical Engineering</td>
<td>1 Environmental Science</td>
</tr>
<tr>
<td></td>
<td>1 Environmental Science</td>
<td>1 Environmental Science</td>
<td>1 Environmental Science</td>
</tr>
<tr>
<td></td>
<td>1 Natural Resources</td>
<td>1 Natural Resources</td>
<td>1 Pre-Pharmacy</td>
</tr>
<tr>
<td></td>
<td>1 Psychology</td>
<td>1 Public Health</td>
<td>1 Veterinary Sciences</td>
</tr>
<tr>
<td>GPA</td>
<td>Mean = 3.88</td>
<td>Mean = 3.69</td>
<td>Mean = 3.689</td>
</tr>
<tr>
<td></td>
<td>Range = 3.65–4.0</td>
<td>Range = 3.03–4.0</td>
<td>Range = 2.414–4.0</td>
</tr>
<tr>
<td>Previous research experience</td>
<td>1–3 years</td>
<td>0–1 year</td>
<td>0–3 years</td>
</tr>
</tbody>
</table>
issues. All students prepared responses to a series of questions on their host country. At orientation, students met with a native of their host country and played a card game called Barn-ga, developed by Doctors Without Borders, which simulates adapting to an unfamiliar culture. They discussed scenarios that were based on dilemmas encountered by past BRAVO! students. Some students visited UA research groups to familiarize themselves with techniques that they would employ (see Table 3 for examples of the students’ projects).

Table 3. A Sampling of Students’ Research Projects by Program

<table>
<thead>
<tr>
<th>Sample BRAVO! Research Projects</th>
<th>Sample Prozkoumat! Research Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific language impairment and the influence of socioeconomic factors in the language production of Spanish-speaking children</td>
<td>Identification of spectrum of Lyme borreliosis spirochete transmitted by ticks in endemic regions of South Bohemia</td>
</tr>
<tr>
<td>Novel mitochondrial morphology in Toxoplasma gondii</td>
<td>Nuclear export of tRNAs in Trypanosomes</td>
</tr>
<tr>
<td>The conflict adaptation effect and dual mechanisms of control</td>
<td>Borreliacidal effect of the tick complement system</td>
</tr>
</tbody>
</table>

**Evaluation**

The evaluation for BRAVO! and Prozkoumat! included surveys, a written mid-experience reflection, reflective journals, exit interviews, and mentors’ evaluations of the students’ performance. Evaluation of the UBRP students consisted of end-of-summer surveys completed by students and their faculty mentors.

**Surveys.** Pre-departure surveys assessed the students’ motivation and preparation for research abroad, whereas post-experience surveys included self-reported scientific and cultural gains. Some survey items were used in 2007 to assess the learning and cultural gains by students in different international science experiences (Bender et al. 2009). Also included were items from the Survey of Undergraduate Research Experience (SURE; see Lopatto 2004). The SURE survey is a Web-based tool that allows students to report learning gains on 21 items associated with participation in undergraduate research. SURE provides comparisons of students’ self-assessed learning gains in a specific program to those reported by students in other undergraduate research programs.

**Mid-experience Reflection.** To help students reflect on the value of their experience, three questions were posed at the midpoint of their experience (questions adapted from Paige et al. 2012; see Table 4), and students submitted written responses to these. This reflection stimulated students’ thinking about how their international experience contributed to their educational and career goals.

Table 4. Items on the Mid-experience Reflection

1. List skills that are important to your field of interest and identify specific experiences you have had overseas that demonstrate how you have developed or honed these skills:

2. Respond to the following hypothetical prompt from a future admissions committee member or employer: “I see from your resume that you did research in [your current host country]. Tell me how that experience makes you a better candidate for this job/graduate/professional program.”

3. Write two or three bullet points that highlight what you will have accomplished, learned, or gotten out of this summer that you plan to include on your resume:

**Reflective Journals and Exit Interviews.** Students in both programs kept reflective journals. Prozkoumat! students had an individual meeting with the on-site faculty facilitator a few days before their departure from the Czech Republic, and BRAVO! students were interviewed upon their return to Tucson.

**Faculty Evaluations of the Participants.** BRAVO! and Prozkoumat! foreign mentors evaluated their mentee at the end of the summer. Questions included five-point Likert scales on which the mentors rated their student’s effort, productivity, learning, and ability to get along with others; the mentors also provided an overall rating and a rating of the benefit derived by their student. The faculty evaluations included the same items used by UBRP mentors that allowed for a comparison among groups (see Table 5).

Table 5. Mentors’ Evaluation of Students by Program

<table>
<thead>
<tr>
<th></th>
<th>Prozkoumat! (n=10)</th>
<th>BRAVO! (n=10)</th>
<th>UBRP (n=103)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effort</td>
<td>4.6</td>
<td>4.9</td>
<td>4.5</td>
</tr>
<tr>
<td>Learning</td>
<td>4.2</td>
<td>4.8</td>
<td>4.4</td>
</tr>
<tr>
<td>Productivity</td>
<td>4.2</td>
<td>4.6</td>
<td>4.4</td>
</tr>
<tr>
<td>Interaction with others in the research group</td>
<td>4.5</td>
<td>4.4</td>
<td>4.6</td>
</tr>
<tr>
<td>Overall rating</td>
<td>4.5</td>
<td>4.9</td>
<td>4.5</td>
</tr>
<tr>
<td>Overall benefit to student</td>
<td>4.2</td>
<td>4.4</td>
<td>4.6</td>
</tr>
</tbody>
</table>

Note: Five-point Likert scale where “5” was outstanding.
Results and Discussion

Influences for Pursuing Research Abroad. Motivation for seeking an international experience differed among groups. Prozkoumat! students were motivated mostly by a desire to learn about the world, to experience a different society and environment, and to achieve personal growth. Other influences included contributing to their major. BRAVO! students were more strongly influenced by a desire to learn about the world and to achieve personal growth. Other strong motivations were to experience a different society and environment, and to build on a prior interest in research or study abroad. The influence of an academic adviser or faculty mentor did not figure largely in most students’ decision to participate. Sixty percent of the Prozkoumat! students and 50 percent of the BRAVO! students indicated that the adviser was not or only “somewhat” a factor in the decision. Thirty percent of each group cited the adviser as “very much” an influence to participate.

Social and Personal Growth. In their mid-experience reflections, BRAVO! students wrote longer and more self-reflective narratives than Prozkoumat! students. In the free-text discussion of skills gained, in addition to technical skills, most students mentioned benefiting from learning to adapt when faced with professional obstacles and having increased skills working with people from different cultures. More BRAVO! students included elements that were personal and showed a larger degree of self-reflection, which was absent from the assignments submitted by Prozkoumat! students. Several students reported feeling more “empowered,” as they had triumphed over obstacles. In the lists of career skills acquired, BRAVO! students were more likely to include elements that were not field-specific techniques, mentioning communication, patience, and networking. BRAVO! students saw their scientific work and the international experience within a broader context than Prozkoumat! students did.

Students in Prozkoumat! and BRAVO! reflected on how they felt they had grown as a consequence of their experience, as illustrated in comments from a Prozkoumat! student’s journal and a BRAVO! student’s mid-experience reflection:

- Prozkoumat! student: “I knew I was going to learn about science and travel but the extent of the experiences was completely unexpected. I would have never thought that I would understand anything about bioinformatics, much less enjoy the work not because I don’t appreciate computers, just a result of being a pessimist. As important as the science I learned & cities I visited, however, were the friends I made. Not only did I leave the Czech Republic w/the knowledge of how to overlay transcription data on genomic libraries and a few miscellaneous Czech phrases, I also have nine new friends to continue spending time with in Tucson. Being in a foreign country (with a very foreign language) brought us close together and kind of expedited the formation of friendships.”

- BRAVO! student: “Participating in research abroad has been one of the most rewarding and difficult experiences I’ve encountered. Changing labs in general is difficult[,] getting used to new methods, rules, and customs takes time. However[,] when paired with negotiating being truly alone in a foreign country makes the experience more challenging. I’ve learned to be adaptable, as I established myself in the lab … I realized that learning new techniques would be a valuable asset I can bring back to my home lab and created a project to enhance my microscopy skills. Outside of the lab, I’ve learned a great deal about adjusting to a new culture. Finding friends was difficult at first, but when I learned to leave behind reservations and be as open as possible, friendships formed easily. My goal is to become a doctor in women’s health. As a doctor, I expect that the majority of my patients will come from very different backgrounds than me. By living abroad, I’ve learned how to find common ground with many types of people. This experience has helped me become mature, take care of myself, learn about science in a unique light, and work with people from various backgrounds.”

It is noteworthy that the Prozkoumat! student refers to the American friends she made, which suggests that a group experience might impede the establishment of friendships with people from the host culture. BRAVO! students, on the other hand, wrote about the friendships they established with people from the host country. Less access to other Americans provides greater impetus to reach out to those from other cultures.

The study abroad literature identifies the Internet as a barrier to students engaging with people in the host culture (Engle et al. 2012). If students stay connected to friends and family at home via the Web, they are less likely to establish connections with those in the new environment. Prozkoumat! students were told that they would have Internet access in their dormitory, but this never materialized. Instead, they had to walk to the institute to obtain online access. One Prozkoumat! student commented on this in her journal, writing:

- “Many of us have given up on getting wifi in the room. However we don’t really mind our evening walks to the Parasitology building in search of the elusive wifi. I’m a little embarrassed that I felt so dependent on the Internet when we first arrived. Being a little disconnected is somewhat of a nuisance but it is probably good for everyone so we interact with each other rather than our devices.”
Internet use is reflected in Figure 1, which shows how BRAVO! and Prozkoumat! students apportioned their time. Students in the Prozkoumat! group reported spending very little time on the Internet with people back home; not surprisingly, the majority of their time was spent with Americans or other foreign visitors. The time of BRAVO! students was more evenly divided among natives of their host countries, with Americans and other foreign visitors, and alone.

**Figure 1. Mean Values for How Students Apportioned Their Time Abroad by Program**

![Graph](image)

Note: One BRAVO! student did not complete this question, so the BRAVO! mean values are based on nine participants.

Sometimes students need to be encouraged into beneficial experiences and an on-site faculty facilitator can be of importance. The Prozkoumat! facilitator arranged for students to engage in a science outreach experience with Roma children. After this, a Prozkoumat! student wrote:

“Today was the science outreach program at the day care center for Romani children. To be honest, I felt rather weary and hesitant about this event given what we were told about the children like their rowdiness and the sheer number of them (40–50). There was also the language barrier as always … I thought this event, doing simple science experiments and demonstrations, would be a mess and/or the kids wouldn’t be interested… I was more than pleasantly surprised when we arrived at the facility and immediately one of the younger participants came up to me and gave me a hug. It was the first moment that I felt needed in the Czech Republic … As for the activities themselves, the kids really enjoyed them all. I later learned that although these children were 6–12 years old[,] they were ‘deemed’ too young for any sort of science and therefore had never seen these simple demonstrations before. It seems totally unfair to me that they are almost being robbed of an important part of their education…”

From other items on the post-experience survey, we learned that all the BRAVO! students felt they learned more about the world and about the place where they conducted their research. This is expected, because BRAVO! students had to take an active role in making their own arrangements. All Prozkoumat! students reported gains in their personal growth from their experience in a foreign environment and felt that they had learned to work successfully with people from a different culture.

Few BRAVO! students (less than half) felt the experience contributed to their major or that they improved their foreign language skills. In the Prozkoumat! group, fewer than half reported gains in their foreign language skills, and several expressed disappointment that no formal Czech language course had been offered before or during the experience. The Czech hosts discouraged learning Czech, feeling that it would be a waste of the students’ time because of the difficulty of the language.

The largest difference between groups in gains was on the “lived on my own” item, which was given higher ratings by the BRAVO! students. This is not surprising, because the structure of Prozkoumat! did not require students to “fend for themselves.” In terms of personal growth, only one of the 20 students failed to indicate growth in “confidence in myself” following the international experience.

**Cultural Gains and Intercultural Competence.** To engage Prozkoumat! students with Czech history, the faculty facilitator arranged for a “Taste of Communism” workshop with a Czech political scientist. Developing an understanding of communism through foods available under the communist regime, before the Velvet Revolution in 1989, put students in touch with the complex issues surrounding life under that form of government. This is exemplified by a journal entry by a Prozkoumat! student:

“This evening we all attended a dinner and presentation on communism. It was definitely the most captivating talk on the subject I have heard … rather than discussing the political aspects of communism, Professor Murad focused on the consumerism of the era … The most interesting topic was the return of traditional communist products in a capitalist market. The main thing these foods were ‘against’ was now the main reason they were popular again. Giant global corporations own the once solely communist products so in a weird way these
candies, canned meats, and Kofola (communist coke) merged these two contrasting systems. (Murad) discussed how there is a divide between those who miss the old ways (ostalgia=nostalgia + east) and those who fear its return...I’ve always thought the system brought more harm than good. I don’t understand how people would ever desire such a political/economic system but today’s presentation definitely shed light on the matter.”

Organized experiences for cultural learning were not available to BRAVO! students. Nevertheless, some BRAVO! students found their own ways of understanding the local culture, as illustrated by a BRAVO! student:

“My largest support in Mexico came from my surrounding (Mexican) friends; I could never have anticipated finding such a supportive group! Starting from my second week there, my friends helped me celebrate my birthday (me, a total stranger) by coming from a final exam with groceries to make fresh guajolotes and spend the night with me. Throughout the summer, they introduced me to art exhibits, live jazz, mescal, and hidden lookouts. We climbed the tallest monolith in the world together, mined for opals, and practiced our new bilingual insults and compliments.”

Scientific Gains. Students’ scientific gains were assessed via the SURE survey and compared to those reported by UBRP students. Mean responses for 21 learning areas are shown in Figure 2.

The highest learning gains among students in all three groups were in learning laboratory techniques and in developing tolerance for research obstacles. These were higher among UBRP and Prozkoumat! students, who were less experienced in research than BRAVO! students. Students in all groups reported similar gains in the clarification of career paths and in self-confidence.

A comparison of the learning gains between students in the two international programs reveals that BRAVO! students gained a better understanding of the research process, the ability to analyze data, and the ability to integrate theory

Figure 2. Survey of Undergraduate Research Experience (SURE) Results
and practice. These gains make sense given that these students already had research experience and thus were able to synthesize their prior work and place it in a larger context.

Prozkoumat! students gained more than BRAVO! students in several areas, including understanding how knowledge is constructed, understanding science, understanding how scientists think, reading and understanding the primary literature, interpreting results, and feeling ready for more demanding research. Students in this group had less research experience initially, so there were more areas of learning in which to grow.

UBRP students had the highest learning gains in 16 of the 21 items assessed. This result points to the gains that can be made by students when they are involved in research on their home campus without the distraction of classes and with a structured professional development program delivered in their native language. BRAVO! students’ means were nominally below the other groups in most areas; however, their data included one outlier who may have affected the means.

Neither BRAVO! nor Prozkoumat! students felt their skills in science writing or oral presentation had benefited—these learning gains were given the lowest rating by most students.

It was not surprising that both the Prozkoumat! and BRAVO! groups reported higher gains than the UBRP group in working independently. Meeting the challenges of a new research environment as well as a new cultural environment may fuel a sense of independence not afforded to students in a domes- tic research program. Comments such as the ones below from a BRAVO! student were common in the journals of both Prozkoumat! and BRAVO! students:

■ “I’ve never been away from home for so long; I’ve had to learn how to navigate a different city alone. I’ve made so many mistakes already, gotten lost more times than I can remember, and wasted time and money. However, through it all, I’ve learned that I can count on myself. Working in a lab taught me this skill (adaptability), but being in a foreign lab where I have even less control has reinforced this.”

BRAVO! and Prozkoumat! students were asked to indicate which accomplishments or benefits they experienced. Nineteen of the 20 students across programs indicated five benefits from their experience: experiencing personal growth; experiencing a different society and environment; learning more about the local politics, culture, environment, and/or history; working and interacting with people from a different culture; and learning more about the world. Nine of the 10 BRAVO! students also indicated that the experience contributed to their undergraduate education and gave them the sense of having successfully lived independently. Nine of the 10 Prozkoumat! students indicated that the experience helped them clarify their long-range career goals.

Another benefit of research abroad is in gaining an appreciation of the value of science as a unifying bridge between cultures. One Prozkoumat! student commented:

■ “This experience has helped me mature my view of the field of science . . . I realized that the major difference between labs across countries was primarily the language barrier. Science seems to be a language similar to math where it seems very pure in its practice and growth and leaves little to be skewed by any cultural or social difference.”

Mentors’ Evaluations. It is important to consider not only students’ self-reported gains but also the students’ research mentors’ assessment of the students’ performance. Each mentor completed an online evaluation of his/her student at the end of the summer, and the mean scores for each item are reported in Table 5.

Mentors’ assessments of students in all programs were very positive. Because the BRAVO! mentors were hosting students who were already well versed in their projects, it is not surprising that the mentors’ evaluations of the BRAVO! students were slightly higher on five of the six areas surveyed compared to the Prozkoumat! students and in four out of six areas compared to UBRP students. The following comment about a BRAVO! student is representative of the comments made by the foreign mentors:

■ “She was a bright student with high motivation and produced work beyond expectations. Her interaction with colleagues was remarkable and her attitude was very mature for her age.”

Several mentors commented that student authors would be included on manuscripts, and one BRAVO! student presented a poster of her work at an international scientific conference.

Conclusion

Undergraduate research abroad programs are broadening experiences for students. Both models for undergraduate research abroad have benefits and drawbacks. The Prozkoumat! model included formal culture learning arranged for and mediated by an on-site facilitator, whereas the BRAVO! students were on their own to experience and navigate their host culture. Neither BRAVO! nor Prozkoumat! had the weekly structured professional development seminars that were part of UBRP (a domestic, undergraduate research program), and this is reflected in their scientific learning gains.

It is unlikely that some Prozkoumat! students would have initiated a research abroad experience under a paradigm that was less structured, but there is no question that they bene-
fitted from the experience. The BRAVO! students seemingly had fewer disciplinary gains but were more experienced in research when they started the program. The social, intercultural, and scientific growth (through networking) they experienced is reflected in their journals and in the assignment written at mid-experience. Our conclusion thus is that it is important to offer both group and solo international undergraduate research experiences and to direct students to the model that best meets their needs.

Limitations
Differences in the backgrounds and underlying motivations of the students who choose to participate in each type of program may affect their comparability. The small sizes of the BRAVO! and Prozkoumat! groups limit the broader conclusions that can be drawn from these findings. There are also many inherent differences between individual students that affect the benefits they realize from research abroad. Still, if viewed in light of these limitations, these findings may provide guidance for future research abroad programs.

Acknowledgments
This project was funded by grants to UA from HHMI (52005889) and NIH (MD001427). The authors thank the scientists who hosted the students; Matt Knatz, MCB IT manager, who devised Web-based survey instruments; and Jennifer Cubeta, UBRP assistant director, who tended to the UBRP students while the UBRP director was with the Prozkoumat! group.

References


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doi: 10.18833/curq/37/3/1
Student-framed Inquiry in a Multidisciplinary Bachelor Course at a Dutch University of Applied Sciences

Abstract
When students explore their own open questions, they learn to be proactive and see themselves not only as consumers but also as producers of knowledge. Such student-framed inquiry has received less research attention. This article aims to shed light on learning outcomes and effects on students’ mind-set and behavior by discussing a course that fosters student-framed inquiry. The one-semester, elective course was open to third- and fourth-year students of various bachelor’s-level programs. A questionnaire was sent to alumni after 11 iterations of the course. The results showed that the course fostered the development of skills in innovation, networking, and cross-boundary collaboration and learning, as well as enhanced personal and professional development. Students became more proactive, less afraid to contact people and take steps to make things happen. The results suggest that courses for inquiry-based learning should include not only more traditional, discipline-oriented research skills and methods but also student-framed methods for design and discovery.

Keywords: undergraduate research, student-framed inquiry, design thinking, student engagement, inquiry-based learning

Introduction
Institutions for higher and vocational education are challenged to educate “knowledge workers”—professionals who are able to solve complex problems collaboratively across disciplines, professions, and perspectives. These knowledge workers are also lifelong learners who acquire and develop knowledge throughout their working life (Tynjälä 1999). As Brew (2010) notes, “The demands of today’s society require higher education to open up to creative solutions to the generation and acquisition of new kinds of knowledge, to new kinds of thinking.”

A possible instruction strategy for fostering knowledge-building capabilities in students is inquiry-based learning (IBL). Levy (2011, 36–37) defines IBL as “a cluster of related pedagogies in which student inquiry or research drives the experience of learning through participation in knowledge building.” Increasingly, this participation is realized by offering students the opportunity to engage in problems or issues in professional practice or the community (such as by service learning or community learning programs).

There is a growing body of research on students’ engagement in research and inquiry that focuses on students exploring questions posed by others such as lecturers, community-based stakeholders, or researchers. However, when students explore their own open questions, problems, scenarios, or lines of inquiry, they learn to be proactive and see themselves not only as consumers but also as producers of knowledge (Neary 2014; Healey and Jenkins 2009). Levy (2011, 39) calls this mode of IBL “student-framed inquiry” (SFI), which ideally focuses on discovery-oriented learning (Spronken-Smith and Walker 2010).

Instructional design for student-framed inquiry has not yet received much research attention. Therefore, this article aims to shed light on learning outcomes and effects on students’ mind-set and behavior after they attended a bachelor’s-level course focusing on SFI. This leads to the main research question: Which learning outcomes and effects on students’ mind-set and behavior can be achieved through a course designed for student-framed inquiry?

To address this research question, the concept of student-framed inquiry and the design of the course will be described. Next, the research method and findings will be presented, followed by conclusions and a reflective discussion.

Student-framed Inquiry
SFI is defined here as “knowledge building that is aimed at addressing a self-chosen problem or issue in professional practice or society through collaboration with peers and relevant stakeholders.” Undergraduate students of a university of applied sciences (UAS) in the Netherlands are the focus of this article. A UAS, also called a vocational university, professional university, or college of higher vocational studies, is an institution of higher education. In the Netherlands, a UAS (referred to in Dutch as a “hogeschool”) grants professional bachelor’s and master’s degrees (see Figure 1). These universities focus on professional practice and practice-based research. The duration of a professional bachelor’s program is typically four years; a master’s program usually takes one to two years of study (EP-Nuffic 2016).

The Council on Undergraduate Research (2016) describes undergraduate research as “an inquiry or investigation conducted by an undergraduate student that makes an original intellectual or creative contribution to the discipline.” However, several authors such as Healey and colleagues (2014), Levy
the imagination, as Brown (2009, 87) notes: “This shift from stages of development. Prototyping, or “thinking with your hands,” entails the use of physical props of the solution, and are of a cyclic nature. Prototypes are used in various stages of development. Prototyping, or “thinking with your hands,” entails the use of physical props as a springboard for the imagination, as Brown (2009, 87) notes: “This shift from physical to abstract and back again is one of the most fundamental processes by which we explore the universe, unlock our imaginations, and open our minds to new possibilities.” Prototypes can take many forms, such as sketches, role plays, scenarios, or artifacts.

In sum, student-framed inquiry at the bachelor level is a practice-based inquiry of a self-chosen problem or issue, and design thinking is considered as a method that can support this process.

The Aims, Context, and Design of a Course for Fostering Student-framed Inquiry

The course, also called the “Da Vinci Minor,” is aimed at educating “knowledge workers”—that is, entrepreneurial, innovative, and creative professionals who are able to direct their own personal and professional development in an ongoing manner. To fulfill this goal, students work on a self-chosen problem or issue in professional practice or society through open inquiry in collaboration with peers and relevant stakeholders. The overall learning outcomes are described in the student guide as five “job requirements” for a knowledge worker, which are presented in Table 1 (Instituut voor Marketing Management 2014).

Table 1. “Job Requirements” for a Knowledge Worker

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Skills in Innovation</strong></td>
<td>Always looking for new combinations, contributing to building new knowledge, and demonstrating ability to let go of paradigms or frames of reference. Applying methods that foster creativity such as developing prototypes and testing them with relevant stakeholders.</td>
</tr>
<tr>
<td><strong>Cross-boundary Collaboration and Learning</strong></td>
<td>Expanding personal expertise and connecting with other people’s expertise. Being a team player and utilizing diversity in a group. Contributing to the team and helping others to learn, including offering and receiving constructive feedback.</td>
</tr>
<tr>
<td><strong>Networking</strong></td>
<td>Initiating and utilizing formal and informal networks; forming partnerships with relevant stakeholders.</td>
</tr>
<tr>
<td><strong>Professional Behavior</strong></td>
<td>Taking responsibility for personal actions, taking into account organization, environment, and society. Behavior is attuned to context and to others. Always seeking dialogue and communicating values and standards.</td>
</tr>
<tr>
<td><strong>Personal and Professional Development</strong></td>
<td>Always looking for opportunities to develop personally and professionally. Insight into own personality, including strengths and weaknesses. Able to reflect on functioning and open to feedback. Able to make explicit what has been learned.</td>
</tr>
</tbody>
</table>
Third- and fourth-year students of all bachelor’s-level programs at Hanze UAS in the Netherlands can enroll in this one-semester elective course for 30 study credits (European Credit Transfer System). Class size varies between 15 and 30 students. Three lecturers and an entrepreneur compose the course faculty. The faculty members work as a team and have competencies in design thinking, coaching, and (self-) reflection.

The course design was based on seven design principles of “hybrid learning configurations” (HLC). An HLC can be characterized as a learning environment at the interface between school and workplace in which students from different study programs work on ill-defined, authentic tasks or issues in professional practice or the community (Cremers et al. 2016). The design principles and examples of corresponding features of the course are described in Table 2.

### Table 2. Design Principles and Features of the Course

<table>
<thead>
<tr>
<th>Design Principle</th>
<th>Features of the Course</th>
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</thead>
<tbody>
<tr>
<td>Fostering Authenticity</td>
<td>Learning is driven by questions or problems in society. Students apply methods such as design thinking to find answers in the form of knowledge and products. Students initiate their own projects, engage stakeholders in the community, and field-test prototypes of their solutions to problems in practice.</td>
</tr>
<tr>
<td>Interlinking of Working and Learning</td>
<td>Students learn by doing, discovering, and making mistakes. Lecturers act mainly as facilitator or coach. Educational interventions include coaching during project work, peer feedback, and feedback from experts and lecturers. Lecturers occasionally provide workshops on topics such as self-directed learning and design thinking. Students organize workshops for each other on study materials related to student-framed inquiry and invite experts to give lectures or workshops. Lecturers assess the students’ work, focusing mainly on the processes (design thinking, self-directed learning) and less on the specific outcomes.</td>
</tr>
<tr>
<td>Utilizing Diversity</td>
<td>Students work alone or in small teams (the latter is encouraged) consisting of students enrolled in different study programs. Students are encouraged to form networks of peers and professionals involved in their topic of investigation.</td>
</tr>
<tr>
<td>Facilitating Reflexivity</td>
<td>Students learn to set their own learning goals, monitor their learning, and make their learning results explicit. Students write weekly logs in which they reflect on critical events that provided learning opportunities. Students offer each other feedback on their self-directed learning activities in peer groups that are initially facilitated by a lecturer but are increasingly run by the students. Students write learning reports twice during the course and present their personal learning outcomes to each other and the lecturers.</td>
</tr>
<tr>
<td>Creating a Learning Community</td>
<td>Students provide peer feedback and support each other in their project work. Students create their own culture and set of rules that reflects a professional working culture and a sense of community. Lecturers are also learners and solicit feedback from each other and students.</td>
</tr>
<tr>
<td>Enabling Organization</td>
<td>Students have their own working space that they are allowed to decorate themselves.</td>
</tr>
<tr>
<td>Enabling Ecology</td>
<td>Enrollment in the course is preceded by an interview to foster commitment and manage expectations. Students form their own networks with stakeholders and experts on their topic. Lecturers often act as “brokers,” helping students find relevant experts inside or outside the university.</td>
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of success has varied from no results at all to projects that continue long after the course has ended.

One project that sought to improve existing products was the development of healthy juices from fresh ingredients. Other examples included an extension of Apple’s iTunes platform, “Hindi Tunes,” which featured Hindi music, and a bike rental system in Groningen based on a similar initiative in Amsterdam. Other students invented new concepts such as a “city wardrobe” service (http://www.stadsgarderobe.nl/), in which bags and coats are stored for shoppers and others in the city center of Groningen. An example of a very complex and successful project was “Local Dreamers” (http://www.localdreamers.org/what-we-do/), which initiates social development projects in Ecuador with international volunteers.

Students receive little guidance for the project work in terms of assignments or scheduled activities. Individual assessment of the overall learning outcomes consists of three parts: an essay on a subject relevant to the student’s project, a report about the new concept or product, and an oral presentation. In addition, the process of self-directed learning is assessed twice during the course by way of a learning report and an oral presentation (see also Cremers et al. 2014).

Method

After 11 iterations of the course, a questionnaire was sent to 100 alumni who had attended the course in iterations 1 (September 2008–February 2009) through 11 (September 2013–February 2014) via LinkedIn (the selection of respondents was based on availability of a LinkedIn account). The total number of students who took the course was approximately 255. Fifty-eight alumni responded (representing a response rate of 58 percent). Every iteration was represented in the responses, with a peak of 18 in 2012.

The questionnaire contained six questions:

1. How do you look back on the course?
2. What did you get out of this course, either during your studies or your professional life?
3. Would you advise others to take this course?
4. When you look back, is there anything that you missed in the course?
5. Based on your experience as a working professional, do you have tips or recommendations for improving the course?
6. What grade would you give the course? (rated 1–10 with 10 = excellent)

The responses were coded using the Atlas-ti program. For this study, answers relating to outcomes and effects of the course were of primary interest. Perception of the course also was included, since this is an indicator for “usability”—the extent to which the course was perceived as a useful and positive experience. The responses were analyzed according to the following criteria: perception of the course, effects on mind-set and/or behavior, and the intended outcomes of the course—that is, the five “job requirements” for a knowledge worker (skills in innovation, cross-boundary collaboration and learning, networking, professional behavior, and personal and professional development).

Findings

The respondents’ perception of the course was positive, without exceptions. The mean score for the course was 8.6. Words that were often used in the responses were fun, freedom, useful, valuable learning experience, pleasure, and enriching experience. Several respondents stated that this was the most valuable course in their bachelor program. Students appreciated the fact that they could choose their own projects. One student said:

- “I finally got an opportunity to do something with my own ideas.”

However, such an outlook did not mean that participation was always easy: a respondent commented that responsibility for one’s own project was scary in the beginning, and collaboration with so many different people could be difficult. Most of the respondents stated that they would recommend the course to others, provided that such students were willing to deal with the freedom and take responsibility for their projects and learning process.

Learning Outcomes. All five “job requirements” were mentioned by the respondents: skills in innovation, cross-boundary collaboration and learning, networking, and professional behavior, as well as the opportunity for personal and professional development.

The most important skill in innovation that was mentioned can be characterized as “think less, do more.” Participants mentioned that in their studies to date, they had been “programmed” to make plans, think, and rethink before taking action. By contrast, the design-thinking method calls for interaction with stakeholders and users of potential products by way of prototyping in every stage of the process, especially in the beginning. This was experienced as a valuable new mind-set that enabled participants to be less afraid to make mistakes:

- “The course taught me that I should not think too much of limitations, but to be open to possibilities. That’s how I got my current job.”

Another skill in innovation was related to creativity or out-of-the-box thinking. Respondents mentioned techniques such
as brainstorming that could enhance creativity. Creativity also could be stimulated by the perspectives of other people. Respondents stated that collaboration with peers from other study programs, with potential stakeholders and users, and with coaches and entrepreneurs enabled them to start looking at things in other ways and to be more open to different perspectives. As one respondent stated:

- “I look at things differently; now I am always looking for things that can be improved and how that could be done.”

Some respondents indicated that they became aware of the value of networking and of how it is done. As one respondent commented:

- “Networking is super important. Sometimes it does not yield a result immediately, but on the longer term it can be very useful.”

The respondents did not mention professional behavior as such, but many of them mention “taking responsibility” and “being pro-active” or “entrepreneurial behaviour” as an outcome of the course. Others mentioned “growing up” during the minor:

- “During the course I started thinking and working in a more professional way. I changed from a student into a working professional. Because of the freedom in the course you realize that you have to do it yourself. I can see this change in my peers as well.”

Two aspects of personal and professional development appeared frequently in the responses: becoming aware of one’s own development, and reflection. Several respondents mentioned the space that was available for reflection on actions and on strengths and weaknesses, for instance:

- “the course provided the opportunity and freedom to figure out what I wanted to do in relation to innovation and entrepreneurship, and in fact also with my future.”

Effects on Students’ Mind-set and Behavior. The course appeared to have an effect on the participants’ further studies and professional career. One participant reported that this impact was negative, such that he now was less able to adjust to environments with many rules and limited freedom. Many respondents reported that they had come to know themselves better, including their talents and weaknesses, as well as the direction in which to proceed. Two respondents indicated that they each “had become more the person that they would like to be.” Other reported effects were mostly related to being more proactive and less afraid to contact people, and to taking steps to make things happen. For example, one respondent commented:

- “I dare say that I have this course to thank for my current job. During my job interview people kept asking about my project. I think the course provided my entry into the company that I work for now.”

Conclusion and Reflective Discussion

Knowledge workers are needed who can solve complex problems collaboratively across disciplines, professions, and perspectives. These knowledge workers are lifelong learners who acquire and develop knowledge throughout their working lives. The findings seem to indicate that student-framed inquiry, as manifested in this course, along with (self)reflection, foster the development of relevant skills of these knowledge workers.

A reflective discussion with two lecturers from the course confirms that the following elements of the course can be considered the main contributors to the impact of the course:

- Students are put in charge of their own projects and their learning activities, and are encouraged to act and involve experts in early stages of their projects;
- Students come from diverse backgrounds;
- Students have regular feedback meetings and participate in celebrations of (small) successes, including a festival showcasing the research projects at the conclusion of the course; and
- Students have the sense of being part of a community of learners in which it is safe to make mistakes.

The biggest challenge for the lecturers was to find a balance between directing and inspiring the students, not being afraid to step back and allow the students to take charge. They learned, however, that it is important to establish the playing field and the rules of the game, especially during the first weeks of the course.

At the same time, it is very important that the lecturers help the students reflect on their personal and professional identity and talents. If the lecturers are role models in the sense that they, too, are learners who have insecurities, doubts, and ability to make mistakes, this seems to give students permission and inspiration to do the same. An example of a playful way of “celebrating mistakes” is a contest among students toward the end of the course, in which the “dumbest mistake” is awarded a small prize. Although the lecturers cannot (and do not wish to) hover over students, they participate with students in an online community or group. It has proven to be very effective (and enjoyable for all parties) if lecturers comment on students’ posts regularly and also post their own reflections, tips, and suggestions. This way, the online community can be a valuable source of knowledge sharing and community building.
The learning outcomes and impact mentioned by the course participants appear to be highly relevant for knowledge workers. This would strengthen the argument for broadening the definition of (undergraduate) research and inquiry, as was done in this study, to include the systematic development of practical solutions along with knowledge that is new to the students and the stakeholders. In addition, this study seems to confirm that open, discovery-oriented inquiry with a high level of student independence can enhance the capacity for student learning, thereby strengthening the teaching-research nexus (Spronken-Smith and Walker 2010). This would imply that courses for inquiry-based learning at the bachelor’s level should include not only more traditional, discipline-oriented research skills and methods but also student-framed methods for design and discovery.

Acknowledgments
The author would like to thank Immo Dijkma and Jorg Andree, lecturers for the Da Vinci course, and the (former) students who responded to the questionnaire for their inspiring contribution to this research project.

References


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doi: 10.18833/curq/37/3/4

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Integrating Undergraduate Research and Study Abroad in an International Studies Curriculum

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The new undergraduate curriculum of the School of International Service (SIS) offers multiple pathways for American University students to integrate research into international experiences. The curriculum provides a framework that allows students to explore their intellectual interests at AU and around the globe, as well as to connect these research experiences to a liberal arts international studies curriculum at SIS. Key elements of the model include an early match of students interested in pursuing systematic research with faculty mentors; a structured advising process via academic advisers, the SIS undergraduate research coordinator, and faculty members to connect coursework, research, and study abroad; a two-semester methods and methodology course sequence that prepares students to conduct independent research; an institutional support structure for undergraduate research at home and abroad; structured pathways for students to pursue research beyond the classroom; and curricular and co-curricular opportunities for students to present and/or publish research.

A typical SIS undergraduate follows a pathway that begins with the exploration of the complexity and diversity of perspectives on a problem or issue in a first-year seminar class. Second-year students complete a two-semester methods and methodology course sequence that introduces students to a range of research methodologies (neo-positivist and non-positivist) and guides them through the completion of an original research project. This course sequence serves as a springboard to subsequent research opportunities, including independent mentored research with SIS faculty members or—more commonly—indpendent research conducted while studying abroad during the third year. Students then may apply for research grants (such as the American University Summer Scholars Research Award, which provides support for structured, mentor-supervised research during the summer between the third and fourth years). Recent Summer Scholars awards recipients have researched the lived experience of refugees from Myanmar in Malaysia, studied the integration of Latino immigrants in Spanish urban centers, and analyzed the growth of anti-establishment parties in established democracies. These scaffolded research experiences culminate with a senior capstone or SIS honors capstone course and project together with the presentation of student research at the SIS Undergraduate Research Symposium and/or the National Conference on Undergraduate Research.

In addition to the standard four-year BA degree the SIS Global Scholars Program, a three-year living-learning community BA program, offers another pathway that integrates undergraduate research and study abroad. Global Scholars complete the same two-semester methods and methodology sequence. However, the second course, Advanced International Studies Research, is taken over the summer as part of an integrated study abroad program held at one or more of American University’s partner institutions (such as the AU Abroad Centers in Brussels and Madrid). Students research their chosen topics in an international environment that offers interaction with faculty experts from partner institutions, ongoing intellectual exchanges with international students, and rich opportunities for original fieldwork.

Overall, undergraduate research as part of a study abroad program or international experience is becoming the norm for SIS students, given the ways in which a pluralistic understanding of research and a holistic understanding of global learning have been integrated into the curriculum, followed by a range of mechanisms for supporting students in their research endeavors.

doi: 10.18833/curq/37/3/10

Frontiers in STEM Study Abroad Undergraduate Research: A New Zealand Case Study

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The structure and short length of study abroad programs (SAPs) are often an impediment to achieving optimal undergraduate research experiences outside the home country. Frontiers Abroad (FA) has met the challenge with innovative programing that embeds the concepts of academic integration and longitudinal learning into its model. Together, these two concepts foster research collaboration between the student and faculty member at both the home and host institutions.

Conventional SAPs are either delivered by a host institution in another country or led by faculty from a home institution that visit the host nation with their students. For STEM SAPs, academic content is either based on a campus of a higher education institution in the host country or delivered from a more remote “field” location. If an undergraduate research experience is meant to be a primary learning goal and/or achievement of the program, this can be difficult to deliver in conventional SAPs, as there is little incentive for host universities to deliver meaningful research experiences for visiting short-term students, and field-based programs may lack appropriate resources (e.g., laboratories). FA has broken SAP convention and established a hybrid model for earth and environmental science programs in New Zealand whereby both field and campus-based learning are combined. Research forms the educational core of FA programs, running from the beginning of a five-week intensive field camp and extending longitudinally to the end of a campus semester. The first four weeks of field camp are designed to incrementally introduce and develop field skills and research techniques. During the final field week, students work with faculty mentors and collect field and/or laboratory data that, via a seamless transition, they carry with them into the campus part of the program.
Their research forms the basis for a semester-long course offered only to FA students, which minimizes the effect of large, domestic-course enrollments. Students are provided with the requisite skills as well as analytical and computational equipment (e.g., geochemical, microscopy, drone, GIS) needed to develop their research from the proposal stage through the experimental/methods stage to ultimately interpret and present their results within the context of published literature. The results are written in a journal manuscript format and presented as a poster display at a formal research symposium hosted by the host university.

The success of this longitudinal learning model is underpinned by curricular and pedagogical integration between the students’ home institutions and FA. FA has promoted trans-Pacific academic integration from the concept stage of program development and has continued with one to three U.S. faculty members joining the New Zealand programs as teachers and/or research mentors every year. Such integration has not only ensured confidence in FA as a leader in STEM education abroad but also, more unexpectedly, research collaborations have organically sprouted with many FA students continuing their New Zealand-based research at their home institution as undergraduate theses. Thus it can be argued that academic integration has extended the longitudinal learning model beyond the abroad program and has led to three peer-reviewed journal publications with students as first author, more than 50 student presentations at the Geological Society of America conference, two collaborative research grants, two students returning to New Zealand as Fulbright Fellows, and one PhD scholarship student continuing her FA research that she started as an undergraduate.

doi: 10.18833/curq/37/3/12

“Community” and “Collaboration” in Undergraduate Language Documentation Research: A Case Study from Nepal and a U.S. University

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A typical image of endangered language documentation is that of the lone-wolf scholar, devoting years to single-handedly describing, analyzing, and preserving a vulnerable language and taking sole credit for these efforts. However, this “single-author” model is changing now, with the rise of team-structure documentation projects and with community-oriented materials designed by faculty, students, and community members. The Documenting the Languages of Manang, Nepal Project (https://mananglanguages.isg.siue.edu) is an example of a next step in the evolution of collaborative documentation and preservation. It demonstrates how faculty and undergraduate students in the Midwest’s Southern Illinois University Edwardsville (SIUE) can gain greater awareness and appreciation of—as well as have a positive impact on—endangered and undervalued languages spoken in another part of the world: Nepal.

With more than 100 languages and a similarly high number of ethnic groupings, Nepal is a country of undisputed ethno-linguistic diversity. It also faces increasingly rapid cultural, political, and economic change with ensuing language displacement. The goals of this NSF-funded project (BCS-DEL 1149639) are to investigate the structure, social functions, and prospects of four languages spoken in the Manang District. Featuring a large-scale design, the methods involve multiple participants at all levels of design and implementation.

The approach embraced by the principal investigator, faculty collaborators, and student researchers is simultaneously “top-down” and “bottom-up,” in that research questions, methodologies, data collection, and outputs are co-constructed and evaluated across all levels. It also involves community-valued outputs. Discussed below are some of the most significant activities as conceived and orchestrated by the undergraduate students recruited through the SIUE program Undergraduate Research and Creative Activities (URCA).

First is the creation of an interactive, multimedia digital archive of narratives recorded from speakers of the languages, which is now housed for free public access at the University of Virginia (UVA). One example may be found at https://audio-video.shanti.virginia.edu/collection/gyalsumo-project. URCA students edited narratives in ELAN, an audio-video annotation and translation program. They also uploaded videos and transcripts to the UVA archive and added meta-data about recording location/time/participants and subject keywords for searchability in the library’s database.

Second is the analysis of sociolinguistic interviews carried out in Nepal with the goal of a coauthored academic journal publication. URCA students assisted with sorting open-ended interview responses into Likert-type categories for quantitative analysis, and they assisted with visualization of response types.

Third is the construction of a word corpus to study tone in these languages. URCA students and graduate research assistants worked together to organize sound files; perform acoustic analysis with Praat software; and prepare data for statistical analysis in programs such as Excel, R, and Vassarstats. Their methods and results were presented at the fourth annual USA Science and Engineering Festival in Washington, DC, in April 2015.

Fourth is the construction of a community dictionary (Gyalsumdo: A Community-Based Dictionary, with Nepali and English Indices). Two SIUE URCA students and one graduate assistant assembled and edited the dictionary with Toolbox software. The final version was published by the Center for Nepal and Asian Study at Nepal’s Tribhuvan University, with 500 copies issued to the Gyalsumdo community free of charge, and was distributed to local primary schools in March 2017.

These activities illustrate the local and international impact of student-generated research that is also truly community-based: it is conducted on, for, and with the community.

doi: 10.18833/curq/37/3/11
Civic Engagement and Community Service at Research Universities: Engaging Undergraduates for Social Justice, Social Change and Responsible Citizenship

Edited by Krista M. Soria and Tania D. Mitchell

Palgrave Studies in Global Citizenship Education and Democracy
eBook ISBN: 978-1-137-55312-6

Reviewed by Susan Berry Brill de Ramírez, Bradley University, brill@bradley.edu

Krista M. Soria and Tania D. Mitchell have brought together 14 essays that argue for civic activity as an integral part of undergraduate education. The three sections of Civic Engagement and Community Service at Research Universities: Engaging Undergraduates for Social Justice, Social Change and Responsible Citizenship support the value and efficacy of an applied civics approach for undergraduates at research universities. The first section delineates those institutional conditions that affect the civics learning and behavior of undergraduates. The second section presents research focused on student participation in community service, including organizational involvement, individual volunteerism, and service learning. Also specified are the various outcomes for student learning, personal growth and maturation, and development into active citizens. The final section examines community service and its role in actual social change and students’ understanding and commitment to social justice.

Soria, Mitchell, and June Nobbe address the history of U.S. civic education, including the development of land-grant universities and the influence of John Dewey’s commitment to civic engagement. In “Developing Undergraduates’ Civic Capabilities,” they write, “In their critical roles as ‘agents of democracy,’ colleges and universities across the USA are charged with preparing their graduates to be active, effective citizens who can consciously contribute to the nation’s dynamic democracy.” Brandon W. Kliwer and Kerry L. Priest reinforce this idea by emphasizing the development of students’ leadership abilities. In “Creating the Conditions for Political Engagement: A Narrative Approach for Community-Engaged Scholarship and Civic Leadership Development,” they point to recent research affirming that “[t]he challenges facing our world require a new kind of leadership and commitment to participation in civic life.”

In her essay “Civic and Community Engagement Impact on Economically Disadvantaged Students,” Victoria Porterfield writes, “Ultimately, the lack of emphasis on civic education from a college or university could have harmful effects on students, and also the nation at large” (68). Therefore, “the quality of classroom activities is essential to enhance civic engagement among undergraduate students” (79). The entire volume underscores the importance of institutional commitments to an applied civics education for student and community well-being. In “Community Service and Service-Learning,” Jeremy L. Williams, Soria, and Claire Erickson note the positive effects from service incorporated into curricula: “Students who participated in service-learning reported higher gains in outcomes associated with liberal arts education, including critical thinking, moral reasoning, inclination to inquire and learn lifelong, intercultural effectiveness, psychological well-being, and political and social involvement” (85).

Noting “the long-held belief that the primary societal benefit of higher education is to cultivate an informed and engaged citizenry” (101), Luis Ponjuan, Cynthia M. Alcantar, and Soria, along with the other contributors, assert that college graduates who combine academic disciplinary learning and other skills become engaged citizens. In their research regarding “Civic Attitudes and the Undergraduate Experience,” Gary R. Kirk and Jacob Grohs note that “in the highly political and competitive, limited resource environment faced by most higher education institutions, prioritizing economic goals often leads to deprioritizing civic goals” (127)—although graduates “with the critical thinking and collaboration skills necessary for meaningful engagement in community” are crucial to resolve “complex problems and deteriorating political dialogue” (127). Additional research in the book supports this finding. In “Pluralistic Outcomes Associated with Undergraduates’ Citizenship Development,” Soria, Matthew Johnson, and Mitchell affirm, “One of the most challenging and yet imperative goals of higher education is to prepare undergraduates to face future leadership challenges and address the most pressing societal demands of the twenty-first century” (165).

The contributors provide extensive data supporting the benefits of institutionally supported service-learning programs. Douglas Barrera, Keali’i Troy Kukahiko, Lauren N. Willner, and Kathy O’Byrne write, “by investing in civic engagement programs,” schools can “provide an ideal opportunity for students to acquire cognitive and affective learning about diversity in diverse environments” (205). Notwithstanding the growth of Campus Compact and the growing number of schools with the Carnegie Community Engagement classification, Walter F. Heinecke, Rose Cole, Jibby Han, and Nqobile Mthethwa document that civic engagement has “made little progress at penetrating the core teaching, learning, and research processes in higher education” and “that the civic engagement movement itself is marginal, stalled, or adrift” (220). The value in educating students to become informed and engaged citizens is clear, but institutional support is required for civics programming that can produce informed and engaged servant-leaders.

doi: 10.18833/curq/37/3/7
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• Title of the article and full journal citation (inclusive pages).
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• Title and department or program affiliation of the faculty member.
• A brief description of the student coauthor(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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