

Learning Beyond the Science Classroom: A Roadmap to Success

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Abstract

Today's college graduates compete in a global market fueled by rapid innovation and constant technological advances. In order to be able to contribute to and advance in these highly demanding careers, workers not only require advanced scientific and technological knowledge but they also need to possess versatility, collaborative problem-solving ability, professional self-confidence, and intercultural communication skills. Many of these latter competencies have been found to be enhanced through co-curricular or experiential activities, like undergraduate research, internships, and community-based learning. Yet, despite these findings most institutions dedicated to the study of basic as opposed to applied science tend to regard experience-based, non-classroom learning as unnecessary for science students. The College of Science at Purdue University, in contrast, has legitimized experiential learning by encouraging students to make co-curricular high impact activities part of their overall academic plan. Students benefit from a roadmap of activities in which to participate as well as coaching through the reflection process. They are prompted to discover a link between their experiences and what they have learned in the classroom, and encouraged to reflect on how their experiences may impact their futures. Completion of the Learning Beyond the Classroom Certificate appears on a student's academic transcript and is noted at graduation.

Keywords: experiential learning, scientific careers, professional development

It is widely accepted that today's college graduates will compete in a global market fueled by rapid innovation and constant technological advances (Hart Research Associates, 2013). They will be required to adapt to new circumstances and avail themselves of opportunities for job mobility throughout their careers. While employers state that college graduates are ready for entry-level jobs, they add that they lack the skills they need in order to be promoted. A report from the Association of American Colleges and Universities questioned "whether graduates are in fact achieving the level of preparation—in terms of knowledge, capabilities, and personal qualities—that

will enable them to both thrive and contribute in a fast-changing economy and in turbulent, highly demanding global, societal, and often personal contexts" (Schneider, 2008, p.2). The Association's "vision for student learning places strong emphasis on global and intercultural learning, technological sophistication, collaborative problem-solving, transferable skills, and real-world applications—both civic and job-related" (p. 3). Many of these competencies are enhanced through co-curricular or experiential activities, like undergraduate research, internships, and community-based learning (Kuh and O'Donnell, 2013). Yet, despite these findings most institutions dedicated to the study of basic as opposed to applied science tend to relegate experience-based, non-classroom learning to "a marginal and rather second-class status" that is "somehow suspect, as if 'real' academics don't do that sort of thing" (Moore, 2013, pp.1-2). The College of Science at Purdue University, in contrast, has legitimized experiential learning, encouraging students to make co-curricular high impact activities part of their overall academic plan and coaching them to elicit meaning from them. Students are rewarded at graduation for doing so.

The Value of Experience

Students in the College of Science have always worked with faculty and staff to develop career skills in our laboratories and classrooms. Today, however, students require other types of experience in order to be competitive in the global workplace. They are urged to take advantage of the opportunities to go beyond the walls of classrooms and labs and put their disciplines into practice in real world settings. In order to emphasize the importance attached to these experiences, students are provided with a roadmap of possibilities and guidance on how to get the most out of these opportunities. Moreover, College of Science faculty have demonstrated their support for experiential activities by recognizing participating students with a Learning Beyond the Classroom Certificate that is recorded on their Purdue academic transcripts. The recent Gallup-Purdue index found that "graduates who had high-impact educational experiences in college are... more likely to be engaged at work" (AAC&U News, 2014, p. 1). Out-

of-classroom activities, such as internships and research, that allow college students to try out what they have learned in the classroom, result in graduates feeling better prepared for life ("Great Jobs Great Lives", 2014).

Undergraduate research, internships, and similar experiences have been characterized as high-impact educational practices (HIP) by Kuh and O'Donnell (2013). Among the characteristics common to HIP activities outside the classroom are:

- Experiences with diversity, wherein students are exposed to and must contend with people and circumstances that differ from those with which students are familiar
- Opportunities to integrate learning
- Opportunities to discover relevance of learning through real-world applications
- Public demonstration of competence

Although these conditions are not all met in every high-impact activity and their intensity varies even within the same type of activity, Kuh and O'Donnell's data show that the influence on students is uniformly positive as reflected in persistence, graduation rates, and desired learning outcomes.

With regard to careers, students in college often begin a process of trial and error, in which they actively experiment and evaluate their opportunities "within a culture that is defined by diversity, investigation, and evaluation" (Waterman and Waterman 1971 as cited by Switzer 2014, p.471). Activities in which students can actually try out behaviors are especially conducive to this exploration. The costs of failure are low, and the opportunities to explore different avenues are great (Kahane, 1997). This period of critical exploration usually concludes with a commitment to a career path that is based upon the self-evaluation of values, abilities and characteristics.

Certain types of high-impact practices are thought to be particularly effective in nurturing engaged, effective and constructive STEM professionals and citizens. Employers agree that the practices that are likely to improve the education of today's college students and prepare graduates to succeed in the workplace include completing an internship or community-based field project and developing the skills to conduct research

collaboratively (79% and 74%, respectively, claim that these will help a lot/fair amount) (Hart Research Associates, 2013). Undergraduate research seeks “to involve students with actively contested questions, empirical observation, cutting-edge technologies, and the sense of excitement that comes from working to answer important questions” (Kuh, 2008a, p. 10). Research professors and their graduate students mentor undergraduate researchers. Internships provide students with direct experience in a work setting—usually related to their career interests—and give them the benefit of supervision and coaching from professionals in the field.

Experience in real world settings is insufficient for real learning to occur (Bass, 2012; Moore, 2013; Vande Berg, Paige, & Lou, 2012). It is through reflection that students make meaning of their experiences. Coaching, or guided reflection on an experience alerts the student to prior misconceptions, conflicting ideas, and generalizable conclusions. According to Rhodes (2014), “Requiring students to reflect on their own learning seems to equip students to internalize and integrate their learning in new ways that strengthen the whole learning process, connecting it to the various aspects of the students’ lived experiences beyond the classroom” (p. 3).

Impact on Student Learning

In general, Kuh and O’Donnell (2013) report that based on several years of NSSE results, high-impact activities, like learning communities, service learning, undergraduate research, and internships benefit participants in terms of deep learning and self-assessed gains in the general, personal, and practical realms. (Deep learning involves higher-order, integrative, and reflective learning.) Research on STEM students who have engaged in such activities show similar results.

Thiry, Laursen, and Hunter (2011) looked at student gains, and the type of activities that led to particular outcomes. “The personal and professional benefits of out-of-class experiences complemented classroom learning” (p. 383). Four relevant sets of gains were examined: becoming professionals, establishing collegial relationships, clarifying career/graduate school plans and preparation, and developing skills. In the area of professional development, “. . . students described adopting the behaviors and attitudes necessary to become a professional” (p. 371). They learned to work and think independently and take “ownership” of a “real-world” project while receiving support and guidance from more experienced professionals within a community of practice. Further, “. . . students described the benefits of establishing a collegial relationship with a mentor and peers and noted increased confidence in their professional skills and abilities” (p. 374). Mentors served as models of professional practice. The opportunity to engage in authentic, professional work with real-world significance

resulted in students feeling that they received greater preparation for their future careers than from coursework alone. Through their experiences, students were able to determine whether their future plans were a good fit for their personality and interests. For instance, research helped students develop an identity as a scientist and an understanding of how scientists practice their profession. Finally, these experiential activities contributed to the development of communication, technical, and organizational skills. (For examinations of the impact of particular types of activities, see Hunter, Laursen, & Seymour, 2007, and Willis, Krueger, & Kendrick, 2013, regarding undergraduate research, and Anakwe and Greenhaus 2000 for a look at internships and professional opportunities.)

Kuh (2008a) notes that many forms of out-of-classroom experiences have significant impact in the production of citizens for a multicultural society. Participation in high-impact activities, such as study abroad, internships, community service, and student teaching, increases the likelihood that students will experience diversity through contact with people who are different from themselves. These experiences challenge students to develop new ways of thinking about and responding to unfamiliar situations. Specifically, with regard to students who study abroad, it has been shown that those who receive cultural mentoring manifest the greatest intercultural development (Paige & Vande Berg, 2012). Community service has been found to lead to increases in student concern for the public good, the importance of making a civic contribution, and leadership skills (Hurtado, 2007). Kuh (2008b) concluded that:

[S]uch an undergraduate experience deepens learning and brings one’s values and beliefs into awareness; it helps students develop the ability to take the measure of events and actions and put them in perspective. As a result, students better understand themselves in relation to others and the larger world, and they acquire the intellectual tools and ethical grounding to act with confidence for the betterment of the human condition. (p. 28)

The Learning Beyond the Classroom Certificate Program

Purdue’s College of Science includes 3300 undergraduate students enrolled in over 40 majors across seven departments. Learning Beyond the Classroom (LBC) is a voluntary program aimed at encouraging College of Science students to engage in experiential learning. In it, students take part in multiple high-impact activities and utilize structured reflection to draw conclusions about the effect of the activity on their skills, interests and futures. Participation in LBC involves attending, organizing, or leading activities that fall into three categories: *career and professional development*; *service, citizenship and*

leadership; and *experience with domestic and international diversity*.

Career and Professional Development includes activities which encourage students to prepare for their careers and futures by exploring opportunities through structured channels; learning to carry out self-directed learning or research projects; and collaborating with or being mentored by a professional. Typical experiences in this category include participation in career exploration, internships, job shadowing, science-based organizations, science-related jobs, and undergraduate research.

Activities included in the *Service, Citizenship, and Leadership* category induce students to learn about and contribute to the community through interactive service activities; enhance their leadership skills; develop and practice empathy for others; and practice working cooperatively. The most popular activities in this category are participating in community service, serving as a College of Science Ambassador, and assisting others as a teaching assistant or tutor.

Finally, *Experience with Domestic and International Diversity* helps students appreciate and understand cultures inside and outside the U.S.; acquire the perspective of a cultural minority; immerse themselves in another culture; and develop intercultural competence. In this area students engage in study abroad, mentoring programs, and diversity organizations. (Tables of activities in each category as well as the associated point distributions can be found in Appendix A.)

Progress in each of the three categories is tracked by a point system. The number of points earned varies with the intensity of the activity. Activities are evaluated on the basis of student reports. Completing the LBC certificate requires that the student:

- Take part in at least one intensive activity lasting an extended period of time, such as semester-long study abroad, a full-time summer internship, two (consecutive) semesters of undergraduate research, an entrepreneurial activity or an academic-year resident assistantship. Such an activity is worth 10 points.
- Accumulate a total of 24 points, with at least 4 points in each of the 3 categories.
- Include either (a) 3 credits of approved coursework from a select list of experiential courses with grades of C– or higher, or (b) a semester-long study abroad program (worth 10 points) or some combination of spring break (4 points) and/or summer study abroad activities (6 points), totaling 10 points.

It is estimated that completion of the certificate takes approximately 30 hours over a student’s college career in addition to the intensive 10-point activity described above.

Upon completion of an activity, students submit reports in which they provide information about and reflect on the experience. For example, for activities

in the career and professional development category students are asked to discuss what they learned from their experience about jobs in general and careers in science in particular. They are asked to speculate on the effect the experience could have on their career and professional development. In the service, citizenship, and leadership category, they are asked how the experience influenced them personally and how it may impact their community involvement and leadership style. In the diversity category, they are asked what they learned about another culture or about people with different backgrounds. Further, they reflect on how the experience might impact their future academic, social, and professional interactions. Students submit the reports, they are reviewed, and feedback is provided. Often, the reporting process is one in which students are coached in discovering a link between their experiences and what they have learned in the classroom. Once it is determined that the student has learned from the experience, the appropriate number of points are awarded.

The College of Science Learning Beyond the Classroom (LBC) Certificate program was launched in Fall, 2011. Currently, approximately 13% of the students in the College (over 400 students) are enrolled in the program. Through December 2015, 114 students have been awarded the LBC Certificate at graduation. Although not enough time has elapsed in order to conduct a systematic assessment of the program, we do have some indication of the benefits and challenges. On the one hand, written communication is challenging for some College of Science students and this creates a barrier to participation in the program. In addition, some students do not see the value in taking part in this voluntary activity as their job prospects are quite good. On the other hand, students who have participated have indicated that writing LBC reports has been valuable in the preparation of graduate and professional school applications as well as in their performance at job interviews. They felt that they were more articulate about their beyond-the-classroom experiences and how they related to their professional development. Following is what students have to say about their particular experience.

In the area of *career and professional development*:

- “Before the (internship), I thought I only had a few options with my chemistry degree: research and teach. After the experience, a new interest was sparked and I fundamentally changed my future career goals.”
- “My time at the corn mill showed me that I am not cut out to be a quality assurance chemist. My work in [a research] lab helped me develop an interest in bacterial pathogenesis, but showed me I do not care for plants. I am much more interested in the human side of pathogenesis. I furthered this interest by researching the immunopathogenesis of dry eye disease, an autoimmune disease. The work showed me that I was still more interested in bacteria than

in other pathogenesis processes. Each experience taught me new skills that have contributed to my career preparation.”

In the area of *citizenship and community engagement*:

- “Tutoring has helped me develop my communication and interpersonal skills. Sometimes, half the battle in helping a student gain understanding is to first promote their confidence and comfort with the subject by encouraging and reassuring them that math and science do not have to be intimidating.”
- “The more important benefit of my involvement in community service, I believe, is the reinforcement that my life must revolve around helping others. Seeing the smile on a child’s face when he sees a “cool” science experiment or better yet, the grin that appears as he begins to truly understand the concept behind the “magic,” is fulfilling beyond the satisfaction of lab-work. . . . Beyond helping people through my career, I hope that my life will always involve volunteer service. Science outreach has been a wonderful way for me to apply my major to help people because science knowledge is something that not just anyone can offer.”

In the area of *domestic and international diversity*:

- “The experience and insights I gained cannot possibly be matched by anything I could do or see in the confines of a classroom. I pushed my physical limits, hand-mixing concrete in the hot equatorial sun, as well as my emotional limits, opening up to a culture I barely knew. The combination of laughter and love made up for the shortcomings of my broken Spanish.”
- “My experience abroad will stay with me in all aspects of my life. For instance, my career goal is to become a doctor. Having been immersed in another culture will help me to keep an open mind with diverse groups of patients. Additionally, the flexibility I learned abroad will help me to be a better physician.”

Lessons for Undergraduate Education

College students today need, expect, and deserve more than intense learning in a discipline. In order to attain “great jobs and great lives,” they require high impact experiences inside and outside the classroom that open up opportunities, reveal options, and develop flexibility. The experiential learning that goes on in the Learning Beyond the Classroom Certificate Program involves students in such experiences. Students have the opportunity to integrate, synthesize, and apply knowledge in unfamiliar situations. They translate thoughts into effective actions. They collaborate with others in settings populated by people from different backgrounds and demographic groups. They make sense of experiences by reflecting on the resources gained and their applicability to their future

careers. In sum, the Program broadens and deepens student learning by promoting a linkage between co-curricular life and the curricular experience. It helps ensure that graduates are prepared for the complex and volatile world of the twenty-first century. An LBC experience provides Purdue College of Science graduates with a unique set of credentials that are documented on their academic transcripts. By helping students learn beyond the classroom, value is added to their degrees and the ways they view themselves and navigate the world are transformed.

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Laura Starr, Director for Experiential Learning and Student Success in the College of Science at Purdue University, develops and administers the Learning Beyond the Classroom program. This program encourages students to take part in activities, such as research, internships and study abroad that allow them to apply what they have learned in the classroom. Dr. Starr coaches students to elicit meaning from their experiences so that deep learning can occur.



Dennis Minchella, Associate Dean for Undergraduate Education in the College of Science and Professor of Biological Sciences at Purdue University, has led successful undergraduate education projects funded by HHMI and NSF. His administrative position and experience in innovations in undergraduate education allow him to support and affect change in undergraduate STEM education. His team has developed college-wide programs to increase student success including the LBC certificate. An award-winning educator, he teaches both a large enrollment biology course for first-year students as well as graduate seminars. He leads a well-established research program that focuses on the evolutionary ecology of host-parasite interactions.

Appendix A

	Career and Professional Development 4 point minimum		
Activity	1 point	2 points	3 or more points
Capstone experience (includes student teaching & entrepreneurship certificate*)			5 points
Career exploration experience	First-year seminar; honors seminar; learning community (3 point limit)		
CoS You Tube video		Create; 2 points per video; 2 video limit in all categories (4 point maximum)	
Departmental research seminar	Attend	Prepare and participate in group presentation	Prepare and present individually
Entrepreneurial activity			Submitted business plan; 5 points*
EPICS	1 point per two hours		
Internship/co-op			Summer/full-time, 10 points
Job shadow	1 day	For one week or less	For more than one week; 4 points
Science Ambassador		For one year	
Science-based organization	Participate	Assist in organization	Lead
Science-related job	1 hour/week per semester	2 hours/week per semester	3 or more hours /week per semester
Science-related publication			Author published article, 10 points; co-author published article, 5 points
Scientific meeting/poster session	Attend	Present poster	Present paper, 5 points
Undergraduate research			5 points/semester for 9 or more hours per week; 4 points/semester for 6-8 hours per week; 3 points/semester for 3-5 hours per week

* Completion of the entrepreneurship certificate can be counted as an intensive activity if and only if in addition to fulfillment of the entrepreneurship certificate requirements, a serious effort has been invested by the student in preparing and submitting a business plan to outside sources for funding or approval.

	Service, Citizenship, and Leadership 4 point minimum		
Activity	1 point	2 points	3 or more points
CoS YouTube video		Create	
EPICS	1 point per two hours		
Intensive leadership development experience	Attend		
Interactive service learning in the community	1 point per two hours		
Resident Assistant (academic year)			10 points (intensive activity)
Science Ambassador		For one year	
Serve on executive board of a recognized student organization		For one year	
Teaching assistant; tutor	1 hour/week per semester	2 hours/week per semester	3 or more hours/week per semester
Work as student employee in campus leadership role		For one year	

	Experience with Domestic and International Diversity 4 point minimum		
Activity	1 point	2 points	3 or more points
Interactive service learning with another cultural group	1 point per two hours		
Domestic or international diversity event or performance	Attend/view	Plan or prepare	Lead or direct
Domestic or international diversity organization	Participate for one year	Serve on executive board for one year	Lead organization, project, or program
Project L.E.A.D or other international or domestic mentoring program			3 points/semester
Resident Assistant (RA) (Academic year)			10 points (intensive activity)
Study Abroad*			Semester, 10 points; summer, 6 points; break, 4 points

*After 3 years of college course work at Purdue or elsewhere in the United States, international students may report about their experiences with American culture for 5 points of diversity credit.